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Notice of Annual Meeting of the Kansas Entomological Society

The 1958 meeting of the Kansas Entomological Society (Central States Entomological Society) will be held at Oklahoma State University, Stillwater, Oklahoma, on 10 May.

THE GENUS *CONOPHORUS* IN NORTH AMERICA (DIPTERA, BOMBYLIIDAE)[1]

RALPH B. PRIDDY
Carthage College, Carthage, Illinois

The genus *Conophorus* Meigen is a fairly large one which includes bee-flies showing considerable variety of morphology and coloration. Of the eighteen species here recognized, three are described as new in the present paper, and four have been described so recently (one by Johnson and Maughan, 1953, three by Priddy, 1954) that their positions in relation to the genus as a whole have not been clarified. Characters not previously used in studies of the nearctic species are introduced here to redefine the genus and to divide it into two groups which may prove to be of subgeneric rank. Individual variation within populations is marked in some of the species, as are also clines, especially in characters of color and pattern of pile and tomentum. The material studied represented all nearctic species except *pictipennis* (Macquart), whose geographic origin is doubtful; both sexes were included for all species seen. Types or paratypes of all except *pictipennis* and *melanoceratus* Bigot have been examined. Material was sent to Mr. J. E. Collin in England for comparison with the types of these two species. The writer has prepared and examined the male genitalia of several species but has not found any characters useful in differentiating critical populations or species.

The writer is greatly indebted to the following institutions and individuals whose help has made this study possible, through loan of material and assistance in many other ways: American Museum of Natural History, J. Bauer, R. H. Beamer, J. N. Belkin, J. Bequaert, G. E. Bohart, Brigham Young University, British Museum (Natural History), California Academy of Sciences, University of California (Berkeley, Davis, Los Angeles, Riverside), Canadian National Collections, Carnegie Museum, M. A. Cazier, H. K. Clench, Colorado A. and M. College, C. H. Curran, P. J. Darlington,

[1] This investigation, conducted while the writer was at the University of Pittsburgh, 1952-1957, was supported in part by a Grant-in-Aid of Research from the Sigma Xi-RESA Research Fund.

Jr., R. J. Frederick, Mrs. Leonora K. Gloyd, Harvard University, W. A. Hilton, F. M. Hull, P. D. Hurd, Jr., University of Illinois, M. T. James, Kansas State College, University of Kansas, Los Angeles County Museum, C. D. Michener, H. Oldroyd, Oregon State College, Academy of Natural Sciences of Philadelphia, J. A. G. Rehn, P. O. Ritcher, H. H. Ross, E. I. Schlinger, H. A. Scullen, G. E. Shewell, Southwestern Research Station,[2] F. S. Truxal, United States National Museum, Utah State Agricultural College, G. E. Wallace, State College of Washington, W. W. Wirth, and many others. A special word of appreciation is due J. E. Collin, J. C. Hall, Mr. and Mrs. D. E. Johnson, and R. H. Painter, who have not spared in their efforts to provide information and material.

DISTRIBUTION AND BIOLOGY

Species of *Conophorus* are found in the Nearctic and Palaearctic Regions. In North America they occur in the western part of the continent; specimens from southern British Columbia; Saskatoon, Saskatchewan; near Denver, Colorado; and Olney and Austin, Texas, mark the northern and eastern limits of the genus as far as known. There is no Mexican material at hand except for a few specimens from northwestern Baja California. *C. pictipennis* (Macquart) was described from "Caroline," which has been interpreted as Carolina, but the species has not been found in American collections. A generalization that may be valid is that the species are found mainly in semi-arid, sub-humid, and dry-summer regions. Some species occur in humid parts of the Pacific Northwest, but the summer rainfall is relatively low in such places. Localities at high altitudes are also noted; for example, some species are taken in the Lake Tahoe region of the Sierra Nevada in California, and one specimen is recorded as taken at 9,000 feet elevation in Utah. Many others are found near sea level, as on the dunes near San Francisco and El Segundo, California.

It is probable that the larvae are parasitic or predatory on immature stages of other insects, as are all Bombyliidae of which the life history is known. The pupa of *Conophorus fenestratus* (Osten Sacken) (Figure 1) has been described (Priddy, 1939, pp. 49-52, "*Conophorus* sp.") but not hitherto illustrated. The fully grown larva was collected by the writer in desert foothills near Whitewater, Riverside County, California, December 29, 1938. It was dug out of coarse sand an inch or two below the surface. No trace of a host was observed. The larva was kept in an otherwise empty matchbox in the laboratory at room temperature; by February 6 it had pupated and by February 24 the adult had emerged.

The larva of *Conophorus auratus* Priddy was collected by E. I. Schlinger at Meyers, near Lake Tahoe, in Eldorado County, California, July 22, 1955, and reared in the laboratory, emerging October 12, 1955. Schlinger communicates the following with regard to his unusual find:

"The larvae (2) were found in the soil (decomposed granite) about two and one half feet deep, while I was digging to uncover a cesspool cover. . . . They apparently were free-living as I looked very carefully for evidence

[2] Part of the research on which the present paper is based was done at the Southwestern Research Station of the American Museum of Natural History.

of bee cells or insect remains, and found none. The larvae were within two feet of each other, looked very much like certain asilid larvae, being all white and rather active, although not able to dig well in the soil of a rearing can. Only one larva emerged; the other died . . ."

The pupa case of this specimen was sent to me through the courtesy of J. C. Hall, and is the only species of *Conophorus* other than *fenestratus* of which I have seen an immature stage.

The adults of *Conophorus* are flower-feeders, as far as known, as are other bombyliids. Van Duzee (1931) records great numbers of *Conophorus atratulus* swarming on flowers of *Baeria chrysostoma* at Templeton, on the banks of the Salinas River, California, on March 22. C. D. Michener collected *C. serratus* on *Baeria* at Rosarito Beach, Baja California, April 2, 1939. *C. fenestratus* has been seen on *Cryptantha microstachys* near Claremont, California, May 7 (Priddy, 1939) settling on the flower for two or three minutes rather than hovering to feed. Meigen (1820) makes the same observation on the genus: *"Sie besaugen die Blumen sizzend, nicht schwebend."* W. F. Barr collected *C. melanoceratus* on *Achillea* (Spalding, Idaho, May 17, 1952) and *C. painteri* on *Eriogonum* (Rock Creek R. S., Minidoka National Forest, Idaho, July 20, 1952) according to pin labels. J. C. Hall (personal communication) mentions collecting *Conophorus* feeding on manzanita, *Eriodictyon, Amsinckia,* and several of the low-growing annuals common in California in the spring.

Genus *Conophorus* Meigen

Conophorus Meigen, 1803, Illiger's Magazin für Insektenkunde, 2:268. Meigen, 1804, Klassifikazion und Beschreibung der europäischen zweiflugligen Insekten 1(2):191. Bigot, 1892, Ann. Soc. Ent. France, 61:360. Kertesz, 1909, Catalogus Dipterorum, 5:103. Coquillett, 1910, Proc. U.S. Nat. Mus., 37:499-647. Becker, 1913, Ann. Mus. Zool. Acad. Imp. Sci. de St.-Pétersbourg, 17:205. Séguy, 1926, Faune de France 13, Diptères (Brachycères), 224. Paramonov, 1929, Trav. Mus. Zool. Kieff, 6:95, 202. Maughan, 1935, Jour. Kansas Ent. Soc., 8(1-2):27-80 (key to Utah species). Type species, by monotypy, *Bombylius maurus* Mikan 1796=*B. virescens* Fabricius 1787.

Ploas Latreille, 1804, Dictionnaire d'histoire naturelle, 24:190. Latreille, 1805, Histoire naturelle des crustacés et des insectes, 14:299. Fabricius, 1805, Systema antliatorum, 2:136. Latreille, 1818, Nouveau dictionnaire d'histoire naturelle, 27:43-44. Meigen, 1820, Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten 2:230-231. Macquart, 1841, Diptères exotiques nouveaux ou peu connus, Mem. Soc. Sci. Arts Lille, 2(1):107 (key to species). Schiner, 1862, Fauna Austriaca: Die Fliegen (Diptera) 1:65 (states without proof that the first citation of *Ploas* Latreille given above is prior to that of *Conophorus* Meigen). Osten Sacken, 1877, Western Diptera, Bull. U.S. Geol. Surv. 3(2):260 (key to California spp.). Coquillett, 1894, Trans. Amer. Ent. Soc., 21:101-102 (key to spp. north of Mexico). Aldrich, 1905, Catalogue of North American Diptera, Smithsonian Misc. Coll., 46(1444):238 (cites Schiner's statement as above, but can find no indication of an earlier date than 1804 for *Ploas* Latreille). Bezzi, 1907, Wiener Ent. Ztg., 26:54-55. Hendel, 1908, Verhandl.

der k.k. Zool.-Bot. Gesellsch. in Wien, 58:43-69. Type species, *Ploas hirticornis* Latreille 1804 = *Bombylius virescens* Fabricius 1787.

Codionus Rondani, 1873, Ann. Mus. Genov. 4:299. Type species, *Codionus chlorizans* Rondani 1873.

Calopelta Greene, 1921, Proc. Ent. Soc. Washington, 23(1):23. Type species, by original designation, *Calopelta fallax* Greene 1921.

The above synonymy is not a complete bibliography for the genus. References listed are for the most part those that deal with the entire genus or with its nearctic representatives as a group. A few errors in Aldrich's "Catalogue of North American Diptera" are rectified here. The corrections include the date 1805 (instead of 1804) for the second citation of *Ploas* Latreille, the use of *Ploas* (instead of *Conophorus*) by Meigen in 1820, and two page numbers.

The distinguishing characters of the genus as it occurs in North America are as follows: Body pilose and bristly; posterior margin of the eyes entire, without any unfaceted indentation; males holoptic or nearly so, females dichoptic, with broad front; pilose areas of the face broad above, and extending upward to the base of each antenna; antennae closely approximated to each other at base; antennae at least as long as the head; first antennal segment swollen; antennal style present; proboscis short or moderate in length, never extending very far beyond the antennae; second vein branching obliquely from the third at a point distant from the anterior cross vein, and ending in the costa; two or three submarginal cells present; first basal cell only slightly longer than the second; four posterior cells present; posterior cells and anal cell open; tibiae with rows of spines (i.e., spine-like setae).

At one time *Conophorus* was believed to be characterized by having three submarginal cells. (See Curran, 1934, p. 197.) It has been shown, however, that *Codionus* Rondani in the Palaearctic Region and *Calopelta* Greene in the Nearctic, described as genera characterized by having two submarginal cells, are not to be regarded as distinct from *Conophorus* (Paramonov, 1929; Painter, 1939). On the other hand, *Sparnopolius anomala* Painter (1939) runs to *Conophorus* in Curran's key in the reference cited above, because it has three submarginal cells whereas other species of *Sparnopolius* have two.

Conophorus as now conceived by the writer may be most readily distinguished from *Sparnopolius* by having the pilose area of the face relatively broad, even at the upper end. This pilosity extends to the base of the antenna on each side, whereas in *Sparnopolius* the pilose area of the face is very narrow above and does not reach the base of the antenna. Other differentiating characters are less sharply marked: *Conophorus* usually has the oral margin less produced; the proboscis in *Conophorus* usually does not exceed the antennae in length, whereas in *Sparnopolius* it is longer; the first antennal segment in *Conophorus* is usually more inflated; and *Conophorus* usually has more numerous coarse, bristly setae on the body. The two genera are closely related and the boundary between them is a tenuous one. The writer is at present investigating *Sparnopolius* and will report on it at a later date.

In nearctic *Conophorus* there are two very distinct species groups, which probably should be regarded as subgenera. These two groups are distinguished most readily by means of a sharply defined character not used for the North American species until recently: the presence or absence of hairs on the metapleura.[3] (See couplet 1 of the key below.) H. Oldroyd states *(in litt.)* that the type species, *C. virescens* (Fabricius), in the British Museum, has metapleural hairs present and the first antennal segment comprising about half the total length of the antenna, although the latter character seems to be variable. In these characters three recently described North American species resemble *virescens,* namely *sackenii* Johnson and Maughan (1953), *chinooki* Priddy (1954) and *columbiensis* Priddy (1954). All other North American species have the metapleura bare and the first antennal segment relatively shorter. According to Oldroyd, Europe likewise has some species with hairy and some with bare metapleura. Further study is necessary involving correlated characters in all species, palaearctic as well as nearctic, before it can be decided whether subgenera should be defined along this line. It may or may not be significant that elsewhere among the Bombyliidae the character of hairy vs. bare metapleura serves to distinguish not only genera but subfamilies (Exoprosopinae and Anthracinae).

Among the nearctic species with bare metapleura, three groups can be distinguished on the basis of proboscis and antennal characters. A somewhat isolated group (*fenestratus* and *collini*) has heavily spotted wings, second and third antennal segments subequal, and long, slender proboscis with small, rounded labella. Another group (*auratus, cristatus, nigripennis, rufulus, hiltoni, obesulus*) is characterized by having a relatively short, stout proboscis with broad labella, usually not extending beyond the apex of the second antennal segment. Most species of this group have shining areas on the dorsal surface of the abdomen, but *auratus* and *cristatus* do not. The third group, consisting of *atratulus, fallax, painteri, melanoceratus, serratus,* and *limbatus,* has the proboscis usually long and slender, with narrow, pointed labella, and has no shining areas on the abdomen. This last group is not so clearly a phyletic entity as the others; its limits and coherence are less sharply defined.

The following key includes all the species recorded from North America except the dubious *pictipennis,* which is discussed at the end of the paper. As explained there, its listing as a North American species may be due to an error in type locality. Also *melanoceratus* and *serratus* are not separated in the key since they form a difficult complex which requires further study to determine criteria for union or separation of these species. Coquillett (1894) provided a couplet for separating them which has proved to be inadequate in the light of present material.

KEY TO THE NORTH AMERICAN SPECIES OF *CONOPHORUS*

1. Metapleura with hairs (on area just ventral to squamae and anterior to base of halter); first antennal segment elongate, usually half the

[3] This sclerite is the metapleura of writers on dipterology; morphologically it is apparently regarded as part of the mesothorax, as illustrated for other Diptera by Snodgrass (1935), p. 185.

length of the antenna, or longer; knobs of halteres black 2
Metapleura bare; first antennal segment usually less than half the length of the antenna 4

2. Scutellum opaque ..... *sackenii* Johnson and Maughan
Scutellum shining 3

3. Second and third antennal segments subequal; antennae with appressed yellow tomentum and black pile ..... *chinooki* Priddy
Third antennal segment nearly twice as long as the second; antennae with few or no yellow hairs ..... *columbiensis* Priddy

4. Wings nearly hyaline, or dark near base and costal margin, gradually fading posteriorly, sometimes with several small dark spots mainly on the cross-veins; third antennal segment about twice as long as the second; proboscis various 5
Wings heavily marked with sharply defined dark clouds; third antennal segment (not including the style) only slightly longer than the second; proboscis long, slender, with small, rounded labella 15

5. Dorsum of abdomen opaque 6
Dorsum of abdomen partly shining; proboscis short, stout, with broad labella 12

6. Scutellum shining 7
Scutellum opaque 8

7. Usually two submarginal cells; first antennal segment elongate, nearly cylindrical as seen from above, usually with appressed yellowish hairs on dorsal surface; wings with slight brownish tinge near base and costal margin; costal serrations in male small to minute ..... *fallax* (Greene)
Three submarginal cells; first antennal segment usually short, thick, and tapering apically as seen from above, with very few or no light-colored hairs; wings with pronounced dark cloud near base and costal margin; costal serrations in male strong to moderate ..... *atratulus* (Loew)

8. Two submarginal cells; palps long, slender, extending beyond oral margin; mesopleura with little or no black pile in male ..... *painteri* n. sp.
Three submarginal cells 9

9. Wings dark near costal margin and with several small but definite dark spots mainly along the cross veins; ocellar tubercle with yellowish and black hairs ..... *limbatus* (Loew)
Wings nearly hyaline; or dark near costal margin, gradually fading posteriorly 10

10. Ocellar tubercle with yellow hairs; proboscis short, stout, extending about to apex of first antennal segment; pile of body mainly yellow ..... *auratus* Priddy
Ocellar tubercle with black hairs 11

11. Proboscis short, stout, with broad labella; sides of abdomen with white pile, alternating with tufts of black pile on the anterior portions of the segments, giving the appearance of transverse stripes ..... *cristatus* Painter
Proboscis long, slender, with narrow labella; sides of abdomen with-

out sharply marked alternating tufts of black and white pile ..... *melanoceratus* Bigot or *serratus* (Coquillett)

12. Ventral parts of head, thorax and abdomen with predominantly white or yellowish pile; halter knobs usually yellow or brown 13
Ventral parts of head, thorax and abdomen with pile all, or nearly all, black; mesonotum with predominantly white or yellowish pile; halter knobs usually black or blackish 14

13. Dorsum of thorax with black pile, usually interspersed with light-colored pile ..... *nigripennis* (Loew)
Dorsum of thorax with reddish or yellow pile, with some black hairs around the edges ..... *rufulus* (Osten Sacken)

14. Dorsum of thorax with some black pile around the edges; mesopleura with fringe of white hairs around lower and posterior margins; some white hairs on venter; sides of abdomen with fringe of alternating black and white tufts ..... *hiltoni* n. sp.
Dorsum of thorax with pile all, or nearly all, yellow; lower part of mesopleura and ventral aspect of body with pile all black or very nearly so ..... *obesulus* (Loew)

15. Scutellum convex, without a median groove ..... *fenestratus* (Osten Sacken)
Scutellum bilobate, with a median groove filled with a dense tuft of yellowish tomentum ..... *collini* n. sp.

Conophorus sackenii Johnson and Maughan

Conophorus sackenii Johnson and Maughan, 1953, Great Basin Naturalist, 13:22-26. Figs. 1, 3 and 9. (type: Herlong, Lassen County, California; Brigham Young University.)

Johnson and Maughan include figures of the wing, head and antenna. The original description is quoted here:

"Black, entirely opaque. Length 6½ to 12 mm.

"Male: Frontal triangle, face and lower occiput grayish, upper orbits brownish pollinose, fading into gray behind and below. Pile of face black, a few yellowish white ones along oral margin, purer white below. Pile of palpi white, except for a few black hairs on tip. Pile of ocellar tubercle black, a row of long black pile behind orbits, rest of pile of occiput white except for a patch of black opposite bases of antennae. Scattered long pale yellowish hair-like tomentum on occiput, most dense in patch of black pile. First segment of antenna nearly cylindrical, one third as wide as long, one and one fourth times as long as other two combined; second cylindrical, twice as long as wide; third segment broad lanceolate tipped with two-jointed style of which the first is as broad as long, the second the same length but hair-like. Antennae faintly brownish gray pollinose, first and second segments with long black pile above, short black pile on outer sides, and long mixed black and white pile below; scattered pale yellowish white tomentum above and below, none laterally. Proboscis reaches to middle of second antennal segment.

"Mesonotum faintly grayish brown pollinose fading to gray forward and laterally, pleurae gray pollinose. Pile of mesonotum mostly black, some

white hairs forward and at sides, longer behind and on humeri, bristles black. Scattering of fine hair-like pale yellow tomentum, more dense on rear of disc. Pile of scutellum long and black, scattered tomentum pale yellow. Mesopleura with patch of white pile, pectus and coxae white pilose. Femora and tibiae yellowish white tomentose and long black and white pilose below. Tarsi reddish at first two joints, spines of tibiae and tarsi black. Wings translucent, tinged with black, which is faintly darker along the veins and almost opaque along the front of the wings, especially in costal, subcostal, and base of marginal cells, darker spots on bases of first and fourth posterior cells. Stems of halteres light yellowish brown, darkening basally, knobs dark brown. Pile at the base of the costa mostly black, with a few light colored ones at very base. Costa not denticulate. Alulae pale yellow with whitish hairs.

"Abdomen faintly brownish pollinose dorsally, lighter at sides; densely yellowish white pilose on first segment at sides with a row of long black hairs on hind margin. Most of rest of abdominal pile black on dorsum, short and sparse except for a row of long hairs on hind margin of each segment, mixed long black and short, more numerous white pile on sides; light colored tomentum dorsally. Pile of venter mixed black and white, mostly white on front half, mostly black on posterior half. Entire venter covered with grayish white tomentum; ground color of hind margins of segments one to five narrowly pale yellow.

"Female: Much like the male except there is less black pile generally, much more tomentum on the abdominal dorsum, more pile on occiput, dorsum of thorax, and abdomen, and the abdomen is broader than that of the male. Front is grayish pollinose below, shading to brownish above, narrowly bare in middle, covered on sides with long black pile and long, sub-appressed, grayish yellow hair-like tomentum."

As noted previously, the presence of pile on the metapleura is a character which *sackenii* shares only with *chinooki* and *columbiensis* among nearctic species, as well as with several palaearctic species of *Conophorus,* including *virescens* Fabricius, *fuliginosus* Meigen and *bellus* Becker, according to H. Oldroyd *(in litt.).* The elongated first antennal segment is likewise found in *chinooki, columbiensis* and *virescens;* I do not know this character in the other palaearctic forms.

This species is the *"Ploas* n. sp." of Osten Sacken (1877), who noticed but did not name it because his specimen (Yosemite, California, June 14, Museum of Comparative Zoology) was denuded.

Specimens have been seen from the following localities:

California: Whitney Road, Lone Pine (June 12), Whitney Portal (July 3), Inyo County; Sardine Creek, 8500 feet (June 28), Mono County; California Hot Springs (July 27), Tulare County; Miami Ranger Station (May 18), Yosemite Valley (June 10), Mariposa County; Strawberry (June 23, 30), Pine Crest (July 1), Tuolumne County; China Flat (June 28), Wright's Lake (July 2), Alpine Creek, Tahoe (July 3), Pyramid Ranger Station (July 12), El Dorado County; Colfax (May 20, 29), Carnelian Bay (July 1), Kings Beach, 5 miles NW (July 5), Placer County; Blue Canyon

(June 15), Sagehen, near Hobart Mills (June 25, July 2), near Hobart Mills (July 5), Nevada County; Sierraville, 12 miles SE (July 4), Gold Lake (July 13), Sierra County; Buck's Lake (June 23), Plumas County; Moose Camp (June 19), Hat Creek P.O. (June 21), Viola (June 27), Summit Lake (July 2), Snow Mt. Road (July 14), Shasta County; Plaskett Meadow (July 12), Glenn County; San Francisco (May 22). Washington: Friday Harbor (June 1), Pullman (no date). Idaho: Pine Creek, 2600 feet, Shoshone County (June 1), Wallace (June 4), summit of Mt. Moscow (June 5). Montana: Two Medicine Lodge, Glacier National Park (July 6). Utah: Emigration Canyon, Salt Lake County (June 18), Logan Canyon (June 20, 24), Silver Lake (no date). Colorado: Walden, 8300 feet (June 17). British Columbia: Goldstream (May 11), Victoria (June 7), Alta Lake, Mons (June 12). Alberta: Lethbridge (June 6), Waterton (June 19), Waterton Lakes (June 28). Saskatchewan: Saskatoon (June 7).

Among individuals seen from these localities are 33 of the paratypes named by Johnson and Maughan.

Conophorus chinooki Priddy

Conophorus chinooki Priddy, 1954, Jour. Kansas Ent. Soc. 27(2):53-54. (type: Chinook Pass, Washington; Carnegie Museum no. 331.)

No additional specimens have been seen since the original description. The close relationship of *chinooki* to *sackenii* is discussed under that species. The antenna of a female collected at the type locality with the holotype is illustrated in Figure 2.

Conophorus columbiensis Priddy

Conophorus columbiensis Priddy, 1954, Jour. Kansas Ent. Soc. 27(2):54-55. (type: Nicola Lake, British Columbia; Canadian National Collections.)

Two additional specimens have been seen since the original description: 1 male, Penticton, British Columbia, June 8, 1933 (J. McDunnough); 1 female, Rimrock, Washington, June 18, 1925 (R. W. Haegele).

This species, like *sackenii* and *chinooki*, belongs to the group with hairy metapleura and elongated first antennal segment.

Conophorus fallax (Greene)

Calopelta fallax Greene, 1921, Proc. Ent. Soc. Washington, 23:23-24. Figure of antenna. (type: Fort Garland, Colorado; United States National Museum.)
Conophorus fallax, Painter, 1939, Trans. Kansas Acad. Science 42:293.

The type is a female (U.S.N.M. no. 23086).

The presence of two submarginal cells instead of three is not a character of generic or subgeneric value in this case, as has been shown by Paramonov (1929) and Painter (1939). It usually serves, however, in conjunction with other characters, to distinguish this species from the closely related *atratulus*. It should be noted, however, that specimens are known (one cited by Painter, 1939, and another seen by the writer) in which one wing has three submarginal cells and the other has two. The specimen seen by the writer has the cross vein in one wing extending from the second vein to a point on the third vein proximal to the point where the latter

branches; the other wing has no cross vein in this sector and therefore only two submarginal cells, but very short spurs are present on the second vein and the anterior branch of the third vein at the points where a cross vein would normally join these veins.

Other characters, however, serve to distinguish *fallax* from *atratulus*: in *fallax* the wings are only slightly clouded, gradually fading posteriorly and toward the apex, without the strong contrast between dark and clear areas seen in *atratulus;* the male of *fallax* has costal serrations small to minute, whereas in the male of *atratulus* they are strong to moderate; the first antennal segment is usually larger, longer, and nearly cylindrical, and with yellowish tomentum on the dorsal surface in *fallax,* whereas in *atratulus* this segment is usually smaller, shorter, tapering apically, and without yellow tomentum on the dorsal surface. *Fallax* has more light-colored pile on the body than *atratulus*. The spur at the apex of the middle tibia is usually longer and brownish yellow in *fallax,* shorter and nearly black in atratulus.

The color of the halter knobs in *fallax* is variable, as Greene indicated. Although the original description gives the color as yellow, the great majority of the specimens seen have dark brown or blackish knobs. A series from Victoria, British Columbia, includes two males and one female with dark halter knobs and one female with yellow knobs.

A male and a female from Hope Valley, Alpine County, California, July 9, 1948 (S. A. Sher) and June 7, 1952 (R. M. Bohart), and two females from Sagehen near Hobart Mills, Nevada County, California, July 2, 1954 (E. I. Schlinger), with three submarginal cells, are near this species. They resemble *fallax* and differ from *atratulus* in having blackish halter knobs, more light pile and tomentum, wings not so heavily infuscated, costal serrations minute in the male, first antennal segment elongate, and with yellow tomentum on its dorsal aspect.

In addition to 1 paratype from "Col." (U.S.N.M. No. 23086) and 2 from Royal Oak, British Columbia (Canadian National Museum), 102 specimens have been seen from the following localities: Colorado: Boulder (May 26); Ft. Collins (May 18). Utah: Alpine (April 25, May 3, 10 and 31); American Fork Canyon (June 9 and 21, July 4); Beaver Creek (June 23); Bellevue, Washington County; Eureka (June 8); Lark (June 10); Parleys Canyon, Salt Lake County (June 11); Provo (April 7); Tony Grove Ranger Station, Cache County (June 30); Uinta County. Arizona: base of Pinal Mts. (March). Idaho: Cascade (June 21); Lava Hot Springs (May 23, June 9); 10 miles north of Nez Perce (May 18). California: Dutch Flat, Placer County (May 20); Alum Rock (April 15); Palo Alto (April 18); San Jose; Twin Peaks, San Francisco (April 3). Oregon: Hood River (June 2); Klamath Falls (May 8); Mosier (May 5); Thorn Hollow (April 29). Washington: Pullman (May 4). British Columbia: Kamloops (May 23); Nicola (May 17 and 29); Nicola Lake (May 29); Oliver (April 23, May 1 and 2); Royal Oak (May 6 and 19); Saanich Dist. (May 20); Taylor (July 3); Vernon (April 11 and 28); Victoria (May 5 and 7, June 6). Alberta: Lethbridge (May 8, 9 and 31); Medicine Hat (May 24). Saskatchewan: Saskatoon (May 9).

Conophorus atratulus (Loew)

Ploas atratula Loew, 1872, Diptera Americae septentrionalis indigena, Centuria 10, no. 44, Berliner Ent. Zeitschr. 16:79-80 (type: California; Museum of Comparative Zoology); Osten Sacken, 1877, Western Diptera, Bull. U.S. Geol. Surv. 3(2):260-261 (key).

Ploas atradula, Coquillett, 1894, Trans. Amer. Ent. Soc. 21:101.

Conophorus atratulus, Kertesz, 1909, Catalogus Dipterorum 5:103.

The single type (Museum of Comparative Zoology, no. 12698) is a female (antenna illustrated in Figure 3). The male is well represented in collections, resembles the female closely and serves as the basis for the following description.

MALE. Ground color black, opaque, dorsum brown and greenish pollinose; scutellum shining black. Occiput yellowish pilose, with black hairs along posterior margin of orbit; ocellar tubercle with black pile; sides of head behind eyes black pilose; face black pilose; chin white pilose. Proboscis extending about as far as apex of second antennal segment. First and second antennal segments black pilose; first and third antennal segments subequal; second antennal segment one and one-half times as long as it is broad, and not more than half as long as the third segment.

Mesonotum black pilose and sparsely yellow tomentose; scutellum black, shining, with long black hairs, at the sides yellowish pilose and tomentose. Notopleural depression and upper margin of mesopleura yellowish pilose; lower portion of mesopleura black pilose with a few yellowish hairs. Wings with heavy blackish infuscation on anterior portion and at base, gradually fading posteriorly to subhyaline. Costa serrate. Knobs of halteres yellow above, blackish brown below. Coxae yellowish pilose, the middle pair with a few black hairs; femora with black hairs and yellow appressed scale-like hairs; tibial spines black.

Dorsum of abdomen with scattered long black pile and sparse yellowish tomentum; sides with long black and short yellowish pile interspersed. Venter sparsely yellowish tomentose, yellow pilose anteriorly, black pilose posteriorly. Length of body, 6.5 mm.; of wing, 5 mm.

Androtype. Male, Dunlap, Fresno County, California, April 9, 1953 (J. C. Hall). California Academy of Sciences. A female with the same collection data as the above male has the following characters: Similar to male; front broad, with black pile and yellow tomentum; dorsum with slightly more abundant yellow tomentum than in male; mesopleura yellowish pilose with some black hairs interspersed; middle coxae yellowish pilose; femora with black hairs and a few yellowish hairs proximally; costa not serrate.

In addition to the type, 273 specimens have been seen from the following localities: Baja California: Ensenada (March 25). California: Riverside (April 4, 26), Herkey Creek, San Jacinto Mts. (May 20), Riverside County; Santiago Canyon (April 11), Orange County; Whittier (March 10), Pasadena (April 2), Burbank (April 15), Newhall (April 15), Los Angeles County; Caliente Mt. 2 miles NE (March 14), San Luis Obispo County; Kernville (March 30), McKittrick (May 2), Woody (March 30), Kern County; Avenal (March 6), Kings County; Coalinga (March 19, April 8), Dunlap (April 9), Panoche Creek (March 24, April 6), Squaw Valley

(April 9), Fresno County; Paicines (April 6), San Benito County; Applegate (April 11), Auburn (April 10 and 11), Loomis (April 10), Placer County; Green Valley (March 30), Solano County; Putah Canyon (March 12, 15, 24, and 31, April 8), Yolo County; Dry Creek Canyon 15 miles north of Napa (April 2 and 28), Monticello (April 8), Pope Valley (March 24), Samuel Spr. (April 2), Wooden Valley (June 11), Napa County; Clear Lake Oaks (April 19), Lake County; Junction State Highways 20 and 16 (April 10), Colusa County; Sutter Buttes (April 2), Sutter County; Forestville (April 20), Geysers (May 5 to 7), Sonoma County; Ukiah (March 31), Mendocino County; Trinity River Camp (June 3), Trinity County.

This common species is readily distinguished from most of the others by the shining black scutellum, opaque abdomen, and absence of sharply-demarcated dark spots on the wings. It bears a superficial resemblance to *columbiensis;* from the latter, as well as from *chinooki,* it is differentiated by bare metapleura and shorter first antennal segment. Characters distinguishing *atratulus* from the closely related *fallax* are discussed above under the latter species.

Conophorus painteri new species

MALE. Ground color opaque black, dark gray pollinose above, light greenish-gray below; posterior segments of abdomen brownish pollinose above. Ocellar tubercle black pilose; occiput black pilose and yellow tomentose above, yellowish pilose below; sides of head below and behind eye with black pile. Oral margin slightly produced; pilose area of face narrow, extending to base of antenna. Face black pilose above, black and white pilose below; chin white pilose. Second antennal segment short, about one and one-half times longer than wide; first and second antennal segments black pilose, the first segment with few short yellowish hairs above. Proboscis extending beyond the first antennal segment but not beyond apex of antenna; palps long, slender, extending beyond oral margin. Dorsum of thorax and abdomen with shining yellow tomentum throughout. Dorsum of thorax with predominantly black pile on center and posterior portions, including postalar calli and scutellum; anterior portion of mesonotum yellowish pilose including most of notopleural depression and narrowly along lateral edges dorsal to base of wing. Scutellum opaque. Mesopleura with pile almost all yellowish, a few black hairs below. Metapleura bare. Wings moderately infuscated at base and near costa, fading into near-hyaline toward apex and posterior margin; two submarginal cells; costa with serrations minute, much shorter than costal setae. Knobs of halteres yellow. Legs black; femora with black and white pile; tibial spines black; femora and tibiae with appressed tomentum mostly yellow on anterior surfaces, white on posterior surfaces. Coxae white pilose. Dorsum of abdomen with row of long black hairs along posterior margin of each segment; shorter pile sparse, mostly black, except on first and anterior part of second segments, which have yellowish pile. Sides of abdomen with yellowish pile and at least a few long black hairs on all segments. Venter

white pilose and tomentose, with a few black hairs near the apex. Length of body (not including antennae), 5.5 mm.; of wing, 5 mm.

FEMALE. Similar to male. Front and upper surface of first antennal segment with black pile and shining yellow tomentum. Dorsum of thorax and abdomen with slightly denser shining yellow tomentum than in male. Anterior part of dorsum of thorax with black and yellowish pile. Mesopleura yellowish pilose. Femora white pilose, with a few black hairs distally. Femora and tibiae with less yellow tomentum than in male. Wings with faint brownish tinge.

Holotype male and *allotype* female, in copulo, American Fork Canyon, Utah, July 4, 1953. (D. E. Johnson) Deposited at Brigham Young University.

Paratypes. Seven males, same data as holotype, in the Johnson Collection; 5 males and 1 female, same data as holotype, in my own collection; 1 male, American Fork Canyon, Utah, July 24, 1953, and 1 male, Aspen Grove, Utah, July 19 (D. E. Johnson), in the Johnson collection; 1 male, Bear Ears, Elk Ridge, Utah (Vasco M. Tanner) (172), Brigham Young University; 1 male, Navaho Lake, 9,000 ft., Utah, June 17, 1940 (R. M. Bohart), University of California at Los Angeles; 1 male, near Saguache, Colorado, July 1, 1937, and 1 male, Saguache, Colorado, August 1, 1937, (R. H. Painter), Kansas State College; 1 female, Evergreen, Colorado, July 2, 1941, 1 male, Evergreen, Colorado, July 10, 1941, and 2 females, Evergreen, Colorado, July 13, 1941 (M. T. James), Colorado A. and M. College; 1 male, Florissant, Colorado, June 24, 1914 (Champlain), Museum of Comparative Zoology; 1 male, Pinecliffe, Colorado, July 9, 1949 (L. D. Beamer), 1 male, Eldora, Colorado, July 12, 1949 (J. R. White), 1 female, Dawson, Colorado, June 30, 1931 (R. H. Beamer), 2 males and 2 females, Lake City, Colorado, June 29, 1937 (R. H. Beamer), Snow Entomological Museum, University of Kansas. This species is dedicated to Dr. Reginald H. Painter, who has contributed so much to our knowledge of the Bombyliidae.

Other specimens: Idaho: 1 male and 4 females, Rock Creek Ranger Station, Minidoka National Forest, July 20, 1952 (W. F. Barr). Utah: 1 male, North Fork Provo Canyon (Elmo Hardy). Colorado: 1 male, Ohio, July 4, 1949 (J. R. White); 1 female, Wilkerson Pass, July 6, 1949, 1 female, Pinecliffe, July 9, 1949, 2 females, Gold Hill, July 10, 1949 (R. H. and L. D. Beamer); 2 females, Littleton, June 24, 1911, (C. A. Frost). New Mexico: 1 male, Santa Fe, July 21, 1926 (E. C. Van Dyke). In these individuals the state of preservation does not warrant designation as paratypes.

Color variations include the following noted in both sexes: total absence of black hairs on first abdominal segment, near-absence of infuscation in wings, and degree to which black pile extends into anterior third of mesonotum. Variations noted in males only include total absence of yellow hairs on upper surface of antennae, and of black hairs on mesopleura, almost total absence of black pile and reduction of yellow tomentum on femora.

C. painteri can be most easily distinguished from *fallax* by the opaque scutellum. *Painteri* also resembles *melanoceratus,* from which it can be separated by the presence of only two submarginal cells. Since abnormal

venation may occur, it should be noted that *painteri* can also be distinguished from *melanoceratus* by long, slender palps extending beyond the oral margin, few or no black hairs on mesopleura of male, usually abundant yellow tomentum on dorsum of male, upper surface of antenna usually with more abundant yellow tomentum in female, and usually longer proboscis.

Two damaged specimens from Logan, Utah, with two submarginal cells probably represent a different species, as the palps are short, the pilose area of the face is broader and the male has more black hair on the mesopleura.

Conophorus melanoceratus Bigot

Conophorus melanoceratus Bigot, 1892, Diptères nouveaux ou peu connus, Ann. Soc. Ent. France, 61:361. (type: "California"; in the collection of Mr. J. E. Collin, Newmarket, Suffolk, England); Kertesz, 1909, Catalogus Dipterorum, 5:103.
Ploas melanocerata, Coquillett, 1894, Trans. Amer. Ent. Soc., 21:102 (key).

The type series has not been seen.

The following is a translation from the French of Bigot's description: "Length 10 to 5 mm.

"♂ Antennae black, the first two segments covered with long black pile, principally below as well as at the extremity; moustache black, very little dense; face black; occiput with long grayish hairs intermixed with black setae; thorax and scutellum black, covered with thick grayish-yellow pile; squamae distinct, white and fringed with white hairs; halteres fulvous yellow; abdomen densely hairy, of the shade of the thorax, but a little less dark and scattered with black setae; feet black; wings hyaline (3 submarginal cells), slightly tinted with reddish at the base, and at the external margin— ♀ Similar to the male; the pile of the body a little more yellowish; the front wide, with yellow pruinosity.

"California, 4 ♂, 4 ♀."

The wing coloration is more accurately slightly blackish, rather than reddish, at the base and costal margin; in the Latin diagnosis accompanying the description, the term "obscuris" is used.

This common species as interpreted at present is a highly variable one with regard to color of pile, wings and degree of serration on the costa of the male. For example, series from some localities have very few or no black hairs on the dorsum of the thorax in the males; those from other localities have the pile on that area predominantly black. There are many individuals with different degrees of intermediate condition, some of them being of the same series as individuals at the extremes of lightness or darkness for the species. This species and *serratus* form a complex which requires further study. The females of the two species are often impossible to separate. Coquillett's key (1894) is entirely inadequate here. Examination of male genitalia has revealed no useful differences within this complex.

Representative individuals from several series keying to *melanoceratus* and *serratus* were sent to Mr. J. E. Collin for comparison with the type series of *melanoceratus*. Collin, in a letter to the writer, gives the following description of the type series:

"[Bigot] stated that he had four males and four females, but in his collection there are three males and five females. He gave the size as '10 vel 5 mm.' and the latter size applies to the three females only which I believe to be females of your 'Auburn' species, and not females of Bigot's *melanoceratus* males. All three of the large males appear to be alike, and to represent a species distinguished by the following characters: Costa with slight serration, more distinct about the region where the first two veins end. Thorax mainly, and scutellum entirely, pale haired, but at least some dark hairs always present on middle of thoracic disc. Notopleural area usually without black hairs (only the normal 2-3 strong black bristles), but there may be an occasional long black hair or two behind the humeri, postalar calli entirely pale haired. Abdomen with obvious black hindmarginal bristles even on second segment, other (shorter) discal hairs pale. Wings not very intensely brownish across base and along costa to end of second vein, and in first basal cell up to (as well as about) discal crossvein (above discal cell), but all somewhat more brownish than in the 'Auburn' males. Of the two large females one is slightly larger than any of the three males, the other about their size. Costa of wings even less brownish. Thorax with more numerous long dark hairs on disc than in males, including some in front of suture, and a few on scutellum. In the larger specimen there are no dark hairs in notopleural depression above the strong black bristles, nor on postalar calli, but there are some black hairs on both places in the smaller specimen."

The "Auburn" reference above is to two series from Auburn, California, of which seven males and seven females were sent for comparison with the types. Individuals of these series are at or near the limit of variation for predominance of light color in several pile and wing characters, and Auburn males have very slight or no serration on the costa. There no longer appears to be sufficient reason for regarding them as a distinct species, because of later examination of intergrading material which was not sent for comparison. Collin did not find any specimen in the material sent him which could be identified with male types of *melanoceratus* Bigot.

Conophorus serratus (Coquillett)

Ploas serrata Coquillett, 1894, Trans. Amer. Ent. Soc., 21:102. (type: Southern California; United States National Museum, no. 10418.)
Conophorus serratus, Kertesz, 1909, Catalogus Dipterorum 5:103.

Coquillett's description is as follows:

"Opaque black, the halteres yellow. Pile of antennae, face, lower half of occiput (usually) and many on upper half, on thorax, scutellum and abdomen black, that on upper half of occiput, on chin, coxae and on sides of basal half of abdomen largely yellow, that on sides of thorax in the female yellow; appressed tomentum of head and body yellow. Wings hyaline, the base smoky brown, this color gradually evanescent posteriorly, leaving a brown cloud on veins at bases of first and fourth posterior cells; costa of male furnished with small, teeth-like projections. Length 6-11 mm.

"Southern California. Seven males and seven females in April, May and December."

Four of the cotypes have been seen, in addition to numerous other individuals.

The status of this species has been discussed under *melanoceratus*. Coquillett's key (1894) characterizes *serratus* as having "pile of thorax and scutellum largely black, costa of male furnished with teeth-like serrations," as distinguished from *melanoceratus* with "pile of thorax and scutellum largely yellowish, costa destitute of teeth-like projections." As explained above, individuals and populations meeting these criteria form a complex with those showing various intermediate conditions with regard to these and other characters.

Conophorus limbatus (Loew)

Ploas limbata Loew, 1869, Diptera Americae septentrionalis indigena, Centuria 8, no. 51, Berliner Ent. Zeitschr., 13:31 (type: New Mexico; Museum of Comparative Zoology.)

Conophorus limbatus, Kertesz, 1909, Catalogus Dipterorum 5:103.

Conophorus limbata, Painter, 1939, Trans. Kans. Acad. Science, 42:393. (Notes on the type and figure of the wing.)

Loew's description is based on a single female type (M.C.Z. no. 12700), now badly damaged. A male designated by Curran as a metatype furnishes material for the following description:

MALE. Ground color black, opaque, dorsum of scutellum and abdomen brownish pollinose. Occiput and ocellar tubercle yellowish pilose, with some black pile interspersed; occiput yellowish tomentose. Face with black pile above, white pile below. Proboscis slender, extending about to the apex of the second antennal segment; labella elongate. Palps stout, white pilose, extending nearly to the upper oral margin. First antennal segment less than two-fifths the length of the antenna, slightly shorter than the third segment without the style; second antennal segment one and one-half times as long as it is broad, about one-third the length of the third segment; first and second antennal segments black pilose with a few grayish hairs.

Mesonotum yellowish pilose, with scattered black pile throughout; scutellum with long black and short yellowish pile interspersed; mesopleura yellowish pilose above, yellowish and black pilose below; metapleura bare; knobs of halteres yellow above, yellowish brown below. Wings with three submarginal cells; subhyaline, slightly infuscated with brown near the

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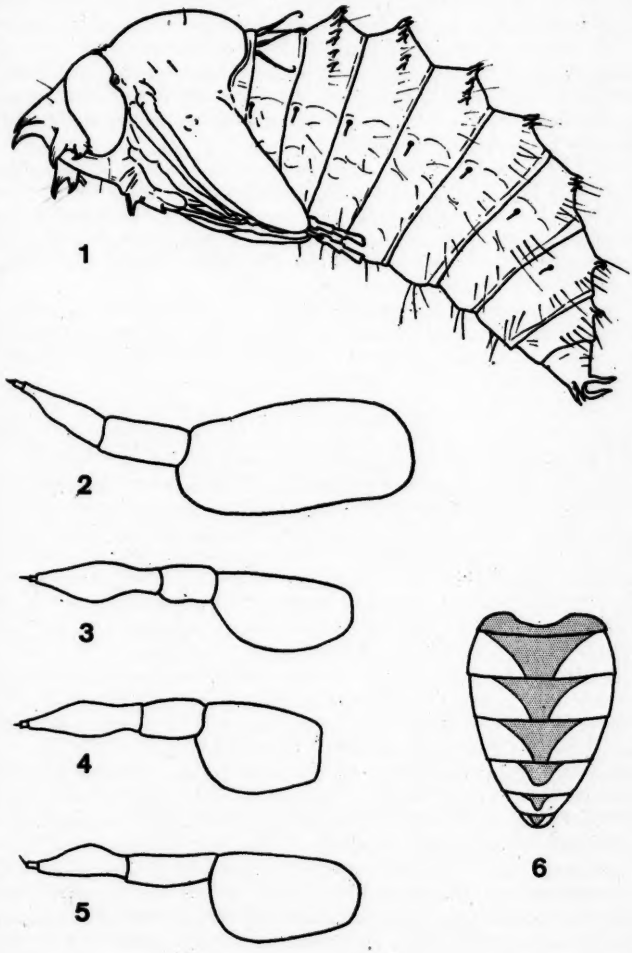
EXPLANATION OF PLATE

1. *Conophorus fenestratus* (Osten Sacken), pupa, length 10.7 mm. In the author's collection.
2. *Conophorus chinooki* Priddy, female, antenna, side view, length 1.4 mm. Carnegie Museum.
3. *Conophorus atratulus* (Loew), holotype female, antenna, side view, length 1.0 mm. Museum of Comparative Zoology type no. 12698.
4. *Conophorus nigripennis* (Loew), holotype female, antenna, side view, length 1.6 mm. Museum of Comparative Zoology type no. 12697.
5. *Conophorus fenestratus* (Osten Sacken) syntype female, antenna, side view, length 2.2 mm. Museum of Comparative Zoology type no. 12702.
6. *Conophorus hiltoni* n. sp., holotype male, abdomen, dorsal view, showing extent of median opaque areas on segments 1-7. D. E. Johnson collection.

costal margin; with dark blackish spots as follows: along the anterior cross vein; along the vein between second basal and fourth posterior cells; a large one along the anterior branch of the third vein between its point of origin and its junction with the sectorial cross vein; along the anterior branch of the third vein near the apex of the wing; along the vein between discal and second posterior cells; on the vein between discal and third posterior cells at its junction with the vein separating these cells from the fourth posterior



cell. Costa not serrate. Legs black; femora and tibiae with appressed yellowish tomentum; femora with black and yellowish pile; tibial spines black; fore and hind coxae yellowish pilose, middle coxae with yellowish and black pile.

Dorsum of abdomen yellowish tomentose; first segment yellowish pilose; second segment yellowish pilose with a row of black hairs along the posterior margin; remaining segments with scattered long black pile. Lateral margins with black and yellowish pile on all segments. Venter with yellowish pile and tomentum. Length of body 9 mm.; length of wing 7.5 mm. Austin, Texas, February 22, 1900 (W. M. Wheeler Collection), compared by C. H. Curran. American Museum of Natural History.

This species is easily distinguished by the pattern of wing markings, as figured by Painter (1939). These markings are much less extensive than in *fenestratus* and *collini;* also the second antennal segment is much shorter in *limbatus* than in these two species.

Two additional specimens (one male and one female, Uvalde, Texas, February 20, 1936 [C. C. Deonier], R. H. Painter collection) have been seen. The male resembles the individual described here. The female is somewhat rubbed; it resembles the male but has the front broad with black and yellowish pile, and has only black pile on the ocellar tubercle. Light-colored pile may have been rubbed from the latter, however.

Two specimens which probably should be referred to *limbatus* are smaller and have more black pile and slightly less spotting on the wings. One male and one female, Olney, Texas, April 10, 1949 (Michener-Beamer), J. C. Hall collection.

Conophorus auratus Priddy

Conophorus auratus Priddy, 1954, Jour. Kansas Ent. Soc. 27(2):55-56. (type: East side of Yosemite National Park, California; U.S. National Museum, n. 62543.)

The *type locality,* which I originally gave as east side of Yellowstone Park, Wyoming, is hereby corrected to the following: east side of Yosemite National Park, California. This correction is made necessary through discovery of a lapse made by the person who originally labeled the specimen I designated as the type. The label reads "East side of Yellowstone Park, Cala., J. B. Lembert, October, 1894." For my description I corrected the state to Wyoming. Subsequent doubts led me to make inquiry of W. W. Wirth, who very kindly communicated the following information:

"Lembert was a settler in the Yosemite Valley who was displaced of his land and cattle grazing by the formation of Yosemite National Park. He was always interested in natural history and H. G. Dyar interested him in insect collecting, beginning in 1891. Thereafter he furnished many rare specimens to people back East, especially the National Museum, until his death in 1896. It seems likely in view of his livelihood that he never collected in Yellowstone and that the persons who labeled his specimens for the National Museum made a lapse of 'Yellowstone' for 'Yosemite.' "

The most significant characters given in the original description include the predominantly bright yellow pilosity, which distinguishes *auratus* from *cristatus;* the wings brown at the base and along the anterior margin, gradually fading posteriorly, differentiating *auratus* from *limbatus,* which

has about six definite dark spots on the wing; and the presence of only yellow pile on the ocellar tubercle, which differentiates *auratus* from all other known species of the genus in North America. A character not recorded in the original description is useful—the proboscis is short and stout with broad labella, and extends only to about the apex of the first antennal segment. This condition is one of the points of similarity linking *auratus* with *cristatus, nigripennis, rufulus, hiltoni* and *obesulus,* and separating it from *melanoceratus, serratus, limbatus* and others. Its comparatively robust size also connects it with the *nigripennis* group.

One additional specimen has been seen, a female, pinned with its pupa case, from Meyers, near Lake Tahoe, El Dorado County, California, July 22. 1955. This individual, together with those listed with the original description, gives the species the distribution pattern Yosemite-Tahoe-Crater Lake. The larva was collected and reared by E. I. Schlinger, emerging October 12, 1955. (See above under "Biology.") This individual has the first and second antennal segments and upper part of the face with long black pile and sparse, short yellow pile interspersed, whereas the holotype and others seen have a dense tuft of yellow pile on the lower aspect of the first and second antennal segments and very little black pile on the face. In other characters it agrees with the holotype.

Conophorus cristatus Painter

Conophorus cristatus Painter, 1939, Trans. Kansas Acad. Science, 42:294 (type: Claremont, California; Kansas State College).

The original description is reproduced here:

"*Male.* Ground color grayish black, entirely opaque, the abdomen somewhat brownish. Head white pilose, ocellar triangle black pilose, a few long, black hairs on the face. First and second antennal segments sparsely black pilose with a few pale yellowish white hairs intermixed especially on the lower side. Thorax white pilose and tomentose with a few black hairs intermixed on the mesonotum, scutellum and in front of the wings. Wings translucent, tinged with black which is darker along all the veins and almost opaque along the front part of the wing especially in the subcosta, costa, and base of R_1. Sectorial cross vein present. Costa of the male with small teethlike projection. Hairs of alulae white. Knob of halteres yellow, the stalk brownish. Legs yellowish pilose, the hairs of the femora long and black. Tibial spines black. Coxae white pilose, the larger hairs with a yellowish tinge. Dorsum of the abdomen curly white pilose with twelve or fifteen long, black hairs along the posterior margin of each segment. The sides of the abdomen white pilose, the anterior parts of the second and following segments with black pile of the same length, a few longer black hairs on the sides of the segments, especially towards the posterior parts. Venter entirely yellowish pilose. Length of body, 11 mm.; of wing, 9 mm.

"*Female.* Almost identical with male, a few black hairs on the occiput, front sparsely long black, and short white pilose. No projections on the costa."

Conophorus cristatus stands between *auratus* and *nigripennis.* From *auratus* it is easily distinguished by having the ocellar tubercle black pilose,

Furthermore the general coloration of the dorsal pile of *auratus* is yellow, whereas in *cristatus* it is whitish and black, and in well-preserved specimens the abdomen has an effect of transverse, whitish stripes due to arrangement of the pile and tomentum. From *nigripennis* it is distinguished by absence of shining areas on the abdomen. *Cristatus* superficially resembles *serratus,* especially in specimens with the abdominal pile rubbed, but has a shorter, stouter proboscis and no yellow tomentum on the front of the female. Presence of lateral abdominal pile reveals well-marked dark tufts at the anterior margin of each segment; these are not found in *serratus.* In males the serration of the costa is variable; some individuals have strong and others have minute serration.

In addition to the type series the following 14 individuals have been seen, all from California: 1 male and 1 female, San Diego County, November 1 and October 15, 1913 (E. P. Van Duzee), California Academy of Sciences; 4 males, Colton, San Bernardino County, 12-3 (Frederick Allen Eddy), Museum of Comparative Zoology; 4 males, Morongo Valley, November 26, 1946, 1 female, Upper Santa Ana River, San Bernardino County, October 7, 1947 (Grace and John Sperry), F. M. Hull collection, University of Mississippi; 1 male and 1 female, El Segundo Dunes, Los Angeles County, October 16, 1947, U.C.L.A.; 1 female, San Luis Obispo, San Luis Obispo County, August 9, Kansas State College.

The last named specimen is in poor condition and of doubtful determination. Also 2 males (Meyers, El Dorado County, September 16, 1951 [E. I. Schlinger], J. C. Hall collection) are near *cristatus* but of generally darker pigmentation.

Conophorus rufulus (Osten Sacken)

Ploas rufula Osten Sacken, 1877, Western Diptera, Bull. U.S. Geol. Surv. 3(2):261 (key). (type: San Geronimo, Marin County, California; Museum of Comparative Zoology.)

Conophorus rufulus, Kertesz, 1909, Catalogus Dipterorum 5:103.

The following redescription is based on the two cotypes, which are males (M.C.Z. type no. 12701).

MALE. Ground color opaque black, pile predominantly reddish and black. Occiput with reddish and black pile; ocellar tubercle black pilose. First and third antennal segments subequal, second segment nearly half as long as the third, not including the style; second antennal segment about one and one-half times as long as it is broad; antennae black pilose, with some sparser, shorter yellow pile on the ventral aspect. Face mostly black pilose above, mostly yellow pilose below; palps and chin yellow pilose. Proboscis short, stout; labella broad.

Mesonotum with reddish pile on the medial portion; mesopleura and notopleural depression with black and reddish pile intermixed; remainder of pleura yellow pilose; postalar calli and scutellum with reddish and black pile intermixed. Metapleura bare. Wings nearly hyaline except for infuscation near costal margin and at base, gradually fading posteriorly. Small dark clouds on cross veins at the apices of the two basal cells. Costal margin with serrations. Halter knobs reddish yellow, brownish below. Coxae with

pile nearly all reddish yellow; middle coxa with a few black hairs. Legs black, femora with black and yellow pile intermixed, and with close-set, appressed, scale-like fulvous hairs. Spines of tibiae black.

Dorsum of abdomen shining black, first two segments opaque, segments three, four, five and six with progressively smaller opaque medial triangles, with the apices directed posteriorly, and extending laterally into transverse opaque bands at the anterior margin of each segment. Dorsum of abdomen with dense reddish pile, and a transverse row of black hairs near the posterior margin of each segment except the first; black pile increasing toward posterior end of abdomen. First three segments of abdomen with lateral fringe of pile almost entirely long, dense and reddish, with few black hairs; remaining abdominal segments with lateral fringe consisting of dense tufts of black pile on the anterior portions of the segments alternating with reddish pile on the posterior portions; apex of abdomen with long black hairs and dense, short reddish pile. Venter with reddish pile, a few black hairs on the fifth and sixth segments. San Geronimo, California, April 19 (Osten Sacken), Museum of Comparative Zoology.

The female has not been previously described, but is found in collections.

FEMALE. Similar to male. Front with black and reddish pile; first and second segments of antennae with reddish pile and a few black hairs; face and palps with abundant long reddish yellow pile. Dorsum of thorax, mesopleura and notopleural depression with reddish pile. Costa of wing not serrate. First four segments of abdomen with lateral fringe reddish. Blue Lakes, Lake County, California, May 16, 1922 (E. P. Van Duzee), California Academy of Sciences.

Some individuals of *rufulus* have no black hairs whatsoever in the anterior part of the lateral fringe of the abdomen, including the first three segments in males and the first four segments in females.

This species is most closely related to *nigripennis*. Some individuals of *nigripennis* approach *rufulus* in reddish pilosity; *nigripennis*, however, has much more extensive intermixture of black hairs, (1) on the anterior and medial parts of the mesonotum, (2) on the mesopleura and notopleural depression in the female as well as the male, and (3) on the lower aspect of the antennae.

In addition to the type series, 27 individuals have been seen from the following localities: California: Paradise Valley, Sequoia National Park, 3000-5000 feet (May 22), Tulare County; Meyers, 5 miles S (July 24), El Dorado County; Applegate (April 11), Baxters (May 20), Placer County; Big Sur (April 7), Monterey County; Santa Cruz Mountains (April 19), Santa Cruz County; San Francisco (May 30); Fairfax (April 22, 25), Ross (April 28), Lagunitas (April 28, May 9), Cypress Landing (March 29, May 7), Alpine Lake (May 9), Tamalpais (May 28), Marin County; Sobre Vista (April 31), Sonoma County; Blue Lake (May 16), Lake County; altitude 5500 (June 14), altitude 6000 (June 20), Trinity County. Oregon: McMinnville (May 1). Washington: Dewatto (June 7).

Conophorus nigripennis (Loew)

Ploas nigripennis Loew, 1872, Diptera Americae septentrionalis indigena, Centuria X, no. 45, Berliner Ent. Zeitschr. 16:80 (type: California; Museum of Comparative Zoology, 12697.)

Conophorus nigripennis, Kertesz, 1909, Catalogus Dipterorum, 5:103.

The single type female (M.C.Z. no. 12697) has been seen (Fig. 4). The following description is based mainly on a specimen of Hy. Edwards, who also collected Loew's type.

FEMALE. Ground color opaque black; abdomen partly shining. Occiput black pilose above, yellowish pilose below; sides of head behind eyes with black pile and yellowish pile interspersed; ocellar tubercle with black pile; front back pilose with sparse yellowish tomentum; face black pilose, with yellowish pile along the oral margin; chin yellowish pilose. First and second antennal segments black pilose with shorter yellowish pile interspersed; first segment nearly two-fifths the total length of the antenna, and about equal in length to the third segment not including the style; second antennal segment about one and one-half times as long as it is broad, and less than half as long as the first segment. Proboscis short, stout, with broad labella; palps not extending beyond the upper oral margin.

Dorsum of thorax with black and yellowish pile interspersed and yellowish tomentum. Upper part of mesopleura with black and yellowish pile interspersed; lower part of mesopleura yellowish pilose; sternopleura and propleura yellowish pilose; metapleura bare. Wings with three submarginal cells; subhyaline infuscated at the base and near the costal margin, gradually fading posteriorly; dark clouds along cross veins at apices of first and second basal cells. Hairs of squamae yellowish. Knobs of halteres brownish yellow above, dark brown below. Femora with black and yellowish pile; coxae with yellowish pile.

Dorsum of abdomen shining black, with opaque areas as follows: the first segment; median, approximately triangular areas on segments two, three, four, five, and six, broadest at the anterior margin of each segment and tapering posteriorly; on segments two, three and four extending to the posterior margin of the segment, on the remaining segments successively smaller and not extending across the segment. Dorsum of first abdominal segment yellowish pilose with a few black hairs; remainder of abdominal dorsum with sparse, coarse black pile and yellowish tomentum, and with yellowish pile near the lateral margins. First three abdominal segments with lateral fringe of yellowish pile with scattered black hairs interspersed; lateral fringe of remainder of abdomen with long black pile, denser on anterior portions of segments, with yellowish pile and tomentum interspersed on posterior portions of segments. Venter yellowish pilose; posterior half with scattered black hairs interspersed. Length of body 10 mm.; length of wing 9 mm.

San Mateo County, California (no. 83, collection of Hy. Edwards), American Museum of Natural History.

MALE. Similar to female; holoptic; lower part of mesopleura with black and yellowish pile interspersed, costal margin of wing strongly serrate; abdomen with lateral fringe of long black pile and shorter yellowish pile

interspersed, the black pile being denser near the anterior margin of each segment except the first.

Marin County, California, March 23, 1897 (W. M. Wheeler collection), American Museum of Natural History.

This species is common and widespread. Further investigation of the considerable intraspecific variation is needed. Some individuals are highly melanistic, with very few light-colored hairs on the dorsal surface of the head, thorax, and abdomen, and with some black hairs interspersed with the light pile on the coxae. Others, nearly all of which are females, have reddish pile replacing yellowish in the characteristic pattern. Intergradation of all the variations with typical *nigripennis* appears to be continuous. Shining and opaque scutellum both occur within this species, opaque being much more common.

Nigripennis is distinguished from *rufulus* by the presence of some black pile, usually interspersed with light-colored pile, on the medial part of the mesonotum, at least on its anterior portion. Nearly all male *nigripennis* are further distinguished from *rufulus* by having the light-colored pilosity yellowish instead of reddish, and also by having the lateral fringe on the first three abdominal segments with black pile interspersed with the light-colored pile, whereas *rufulus* has only light pile here. Female *nigripennis* is distinguished from female *rufulus* by having no more than the first three abdominal segments with light-colored lateral fringe, whereas female *rufulus* has this fringe light on the first four segments. Some *nigripennis* females have black pile absent from the central area of the mesonotum (but not from its anterior margin) and thus approach male *rufulus* in pattern. *Nigripennis* is distinguished from *hiltoni* by the predominantly light-colored pilosity of the venter and at least partly yellow halter knobs.

In addition to the type, 316 individuals have been seen from the following localities: California: San Miguel Island (May 5); Dulzura, 2800 feet (March 23-25), Alpine (April 9), San Luis Rey Camp (April 23), San Diego County; Riverside (March 3, 4, 7, April 1, 8), Riverside, 4 miles S (April 20), Corona (March 25), San Jacinto Mts. (May 30), Fern Valley, San Jacinto Mts. (June 7), Idyllwild (June 10), Tahquitz Valley, San Jacinto Mts. (June 20), Marion Mt. Camp, San Jacinto Mts. (July 1), Riverside County; Crafton (March 16), Redlands (March 20), Mojave Desert (April 11), Big Meadows (April 27), Lytle Creek (May 15), Upper Santa Ana River (May 20, June 3), San Bernardino County; Beverly Glen (February 22), Switzer's Camp, San Gabriel Mts. (February), Pasadena (March 1, 9, April 10), Monrovia Canyon (March 13, 27), Santa Monica Mts. (March 20), Mill Creek, San Gabriel Mts. (March 31), Placerita Canyon (April 22), Angeles Crest Highway (April 22), Claremont (no date), Los Angeles County; McKittrick (May 2), Kern County; Pismo (April 25), San Luis Obispo County; Stone Canyon (April 27), Tassajara Hot Springs (May 29), Monterey County; Santa Cruz Mts. (April 20), Santa Cruz (May 10), Big Basin (July 21), Santa Cruz County; San Jose (March 5, April 9), Black Mountain, Palo Alto (April 20), Los Gatos (May), Mountain View (May), Mt. Hamilton (June 2), Santa Clara County; San Mateo County, no locality; San Francisco (March 28); Berkeley (March 19, April

12, 21, 25, May 20), Piedmont (March 30, April 20), Oakland (March 31), Tilden Park (April 4), Oakland Hills (May 1), Alameda (no date), Alameda County; Mt. Diablo (February 23, March 26, April 22), Antioch (April 11, 18), Contra Costa County; Auberry (April 12), Fresno County; Yosemite (May 19, 22, 28, June 9, 13), Mariposa County; Strawberry (May 31?), Fallen Leaf Lake (June 16), China Flat (June 28), Alpine Creek, Tahoe (July 7), Angora Lake, Tahoe (July 11), Pyramid R.S. (July 12), Zephyr Cove, Tahoe (September 30), El Dorado County; Loomis (April 11), Dutch Flat (May 2), Baxters (May 29), Kings Beach, 5 miles NW (July 5), Placer County; Truckee (June 15, 18), Donner Pass (June 18), Sagehen, near Hobart Mills (June 25, July 2), Nevada County; Webber Lake (July 23), Sierra County; Sacramento (March 24), Sacramento County; Yankee Hill (March 20), Chico (April 26), Butte County; Meadow Valley, 4000-5000 feet (June 12), Meadow Valley, 5000-6000 feet (June 20), Silver Lake (June 19), Quincy, 4 miles W (June 22). Buck's Lake (June 23, July 1), Nelson Point (July 5), Plumas County; Herlong (May 7), Bridge Creek Camp (July 9), Susan River Camp (July 10), Lassen County; Mill Valley (March 11, 18, 27), no locality (March 23), Fairfax (April 3), San Geronimo (April 19), Tamalpais (April 21), Alpine Lake (May 9), Marin County; southern Sonoma County (March 19), Spring Mountain (April 10), San Rafael (April 12), no locality (April 27-May 9), The Geysers (May 5-7), Stillwater Cove (May 23), Mesa Grande (June), Sonoma County; Pope Valley (March 24), St. Helena, 6 miles W (May 15), Napa County; Putah Canyon (March 12-20), Yolo County; Blue Lakes (May 16), Midlake (May 30), Lake County; Plaskett Meadow (July 13), Glenn County; Yorkville (April 21, 30, May 17, 23), Hopland (May 28), Ryan Creek (June 1), Mendocino County; Blocksburg (May 25), Fort Seward (June 14, 16), Bairs Ranch, Redwood Creek (June 19), Blue Lake (June 20-27), Orick (July 9), Humboldt County; Fawn Lodge (May 28), Trinity County; Pot Spring (June 24), Shasta County; Bartle, 5-10 miles NW (June 20), Pondosa (June 20), Siskiyou County. Oregon: Corvallis (April 8), Marys Peak (April 12), Warner Mts., Lake County (June 19, 20), Griffin Creek, Jackson County (June 29), Grants Pass (July 8). Washington: Olympia (May 15, 26, 28), Sumner (May 25, June 6, 22), Toppenish (July 8). Nevada: Carson City (May 25, July 10). Utah: Mill Creek Canyon, Salt Lake County (June 8), Lark (June 10). British Columbia: Fitzgerald (May 22), Hotel Lake, Pender Harbor (May 27, June 2), Victoria (June 9), Departure Bay (June 29, 30), Goldstream (July 4).

Conophorus hiltoni, new species

MALE. Ground color black, opaque; scutellum and abdomen partly shining. Occiput black pilose above, white pilose below; sides of head behind eyes black pilose with sparse white pile and tomentum interspersed; chin and face black pilose with sparse short white pile along lateral oral margins. First and second antennal segments black pilose with a few white hairs on lower surface of first segment; first antennal segment about two-fifths the total length of the antenna, and about equal in length to the third

segment; second antennal segment about one and one-half times as long as it is broad, and less than half as long as the first segment. Proboscis short, stout, extending about as far as the second antennal segment; palps flattened, broad, not extending as far as the upper oral margin.

Mesonotum white pilose; with stout black pile interspersed along anterior margin, throughout anterolateral portions including notopleural depression, along lateral margins and on postalar calli. Scutellum with black and white pile interspersed; with apex shining black. Mesopleura black pilose above, with some shorter white pile interspersed; with fringe of white pile along lower and posterior margins. Sternopleura and propleura with black and white pile intermixed; metapleura bare. Wings with three submarginal cells; subhyaline, clouded with yellowish brown at base and near costal margin, gradually evanescent posteriorly; dark gray clouds along cross veins at apices of first and second basal cells. Costa strongly serrate. Hairs of squamae yellowish. Knobs of halteres black. Legs black pilose; coxae with some white pile interspersed.

Dorsum of abdomen shining black, with the following parts opaque: the first segment; median, approximately triangular areas on all the remaining segments, broadest at the anterior margin of each segment and tapering posteriorly; on segments two, three and four extending to the posterior margin of the segment, on the remaining segments successively smaller and not extending across the segment (Fig. 6). All segments of abdominal dorsum black pilose, with some shorter white pile at anterior margins and lateral portions of the segments; with curly white tomentum, mostly on anterior and lateral portions of the segments. Lateral fringe of abdomen with long black pile, denser on anterior portions of segments; with white pile and tomentum near posterior margins of segments. Venter with black pile and white tomentum. Length of body 10 mm.; length of wing 9 mm.

FEMALE. Similar to male; front black pilose, white tomentose; costa not serrate; wings less darkly clouded; opaque triangles of abdomen narrower than in male but still present on all segments; anterior margins of segments of abdominal dorsum with denser, longer tomentum, densest in the median line, on the opaque triangles.

Holotype male and *allotype* female, Herlong, Lassen County, California, May 14, 1944 (D. E. Johnson); deposited in Brigham Young University. *Paratypes,* 1 male and 2 females, same data. No other specimens have been seen. This species is dedicated to Dr. William A. Hilton.

C. hiltoni may be regarded as intermediate between *obesulus* and *nigripennis*. It is distinguished from *obesulus* by the presence of some white hair on the sides and lower parts, including propleura, mesopleura, sternopleura, coxae and venter; the abundant black pile on parts of the mesonotum and on the scutellum; the arrangement of white tomentum on the dorsum of the abdomen; and the alternating black and white in the lateral fringe of the abdomen. From *nigripennis* it is easily distinguished by the black halter knobs and black pile on the venter.

Conophorus obesulus (Loew)

Ploas obesula Loew, 1872, Diptera Americae septentrionalis indigena, Centuria 10, no. 46, Berliner Ent. Zeitschr., 16:80 (type: California; Museum of Comparative Zoology); Osten Sacken, 1877, Western Diptera, Bull. U.S. Geol. Surv., 3(2):260 (key); Coquillett, 1894, Trans. Amer. Ent. Soc., 21:101-102 (key).
Conophorus obesulus, Kertesz, 1909, Catalogus Dipterorum, 5:103.
Ploas amabilis Osten Sacken, 1877, Western Diptera, Bull. U.S. Geol. Surv. 3(2):261-262. (type: Yosemite, California; Museum of Comparative Zoology.)
Conophorus amabilis, Kertesz, 1909, Catalogus Dipterorum, 5:103. New synonymy.

Although Loew indicates that his description is based on specimens of both sexes, the type series of *obesula* (M.C.Z. no. 12699) consists of three males; no female type of *obesula* is known to the writer. Maughan (1935) figures the antenna and wing, as of *C. amabilis*.

The following description is based in part on the type series and also on an additional male [San Francisco, California, May 12, 1915 (M. C. Van Duzee), California Academy of Sciences] to supply characters obliterated in the types:

Ground color black, opaque; abdomen partly shining, metallic blackish green. Occiput black pilose and yellow tomentose above, yellow pilose below; sides of head behind eyes, ocellar tubercle, face and chin black pilose; first antennal segment about two-fifths the total length of the antenna and about as long as the third segment, not including the style; second antennal segment less than half the length of the third segment and about one and one-half times as long as it is wide.

Mesonotum yellow pilose, with black pile intermixed in some specimens on anterolateral angles, notopleural depressions, lateral margins, or postalar calli. Scutellum yellow pilose, some individuals with scattered black or bicolor (brown and yellow) hairs intermixed. Apex of scutellum opaque. Pleura with black pile, except upper fringe of mesopleura, which is yellow pilose. Wings infuscated with dark brown at base and along costal margin, fading to subhyaline posteriorly; dark spots on cross veins at apices of first and second basal cells. Costa strongly to moderately serrate. Halter knobs black. Squamae with fringe of yellow hairs. Legs black, coxae and femora with black pile; tibial spines black.

Dorsum of abdomen shining, metallic blackish green posteriorly and at the sides; segments 1 and 2 entirely opaque; segment 3 opaque except for small shining spots at the sides; segment 4 with broad opaque median area tapering posteriorly; segments 5, 6, and 7 with successively smaller opaque median triangles. Dorsum of abdomen with yellow or bicolor (brown and yellow) pile, with scattered black hairs intermixed. Segments 5, 6, and 7 with black pile predominant, yellow or brown-and-yellow hair interspersed. Sides of abdomen with fringe of black pile, sometimes with some yellow hairs in upper part of fringe on segments 1, 2, and 3. Venter black pilose. Length of body, 9 mm.; of wing, 8 mm.

The female, not hitherto described separately, differs from the males of the type series as follows:

Front black pilose and yellow tomentose. Mesonotum and scutellum yellow pilose; wings less infuscated than in male; costa not serrate. Abdomen shining, with smaller opaque areas than in male, as follows: segment

1 opaque; segment 2 opaque except for small shining areas at the sides; segments 3 and 4 with opaque strip along anterior margin continuing into a narrow median triangle; segment 5 with small median opaque line on anterior half. Dorsum of segments 1, 2, and 3 yellow pilose; dorsum of remaining segments black pilose; sides of segments 1, 2, and 3 with fringe of yellow pile, and with some black pile below not visible from dorsal aspect; sides of remaining segments black pilose. Length of body, 8 mm.; of wing, 7 mm. San Francisco, California, May 12, 1915 (M. C. Van Duzee); California Academy of Sciences.

This female had been previously determined as *amabilis,* quite in accordance with previous keys and description, whereas a male of the same date, locality and collector had been referred to *obesulus*. This male closely resembles the type series of *obesulus*.

Amabilis can no longer be regarded as a distinct species with the material now available for study. One of the characters hitherto used to differentiate *amabilis* and *obesulus* is the extent of opaque areas on the dorsum of the abdomen. Although the original description of *amabilis* states that the abdomen is shining except for the first segment, actually the *amabilis* types have at least a small opaque triangle on the second segment, and in the other material seen a gradient exists between this condition and the much larger opaque areas found in the type series of *obesulus*. Also males have more extensive opaque areas than females of the same series.

Another character hitherto used to distinguish *amabilis* has been the presence of only light pile on the anterior three segments, and only black pile on the remainder, of the abdominal dorsum; on the other hand, *obesulus* has been characterized by interspersed black and light pile on all or nearly all of the abdominal dorsum. It is found, however, that in some series, including the pair from San Francisco described above, the males have a pile pattern approaching or identical with that of the *obesulus* types, and the females one resembling that of the *amabilis* types. A male from Eagle Ridge, Klamath Lake, Oregon, May 16, 1924, has the *"obesulus"* pile pattern, whereas a female from the same locality, June 2, 1924, otherwise very similar, has the *"amabilis"* pattern. In both of these individuals the opaque areas of the abdomen are very small. Thus in pile pattern they follow the San Francisco pair, whereas in degree of opacity they both resemble the types of *amabilis*.

In a series of 6 males and 2 females, Sonora Pass, California, June 27, 1951, most of the males have the pile on the dorsum of the abdomen all light, but two have a few scattered black hairs interspersed throughout. The females have the pile of the abdominal dorsum all light on the first three segments, and light with some black interspersed on the remaining segments. The males have small opaque areas on segments 1-6, the females on segments 1-3. Thus the pile and opacity characters are seen to vary independently; the opaque areas are intermediate in extent between those of the *obesulus* and *amabilis* types, whereas most of the males have less black pile than either the *obesulus* or *amabilis* types.

Still further variation is seen in a series of 2 males and 1 female from Lind, Washington, April 25, 1919. The males have all light pile on the

dorsum of the abdomen; the female has light pile on this region, with a few black hairs on the fifth and following segments, and also has the lateral fringe of the abdomen with some black pile on all segments. The extent of opacity is intermediate, being almost the same as in the Sonora Pass series. Here the female is unusual in having the anterior part of the lateral fringe mostly black, in this resembling the typical males of *obesulus*.

Of two females from Shingle Creek Road, Keremeos, British Columbia, one has the opacity on the second abdominal segment hourglass-shaped, i.e., broad at anterior and posterior margins of the segment and narrowed at the middle, approaching the condition in the female *obesulus* described above; the other has only an opaque triangle in the anterior half of the segment, approaching the female type of *amabilis*. Both have the pile of the abdominal dorsum in the *"amabilis"* pattern.

Specimens from the San Francisco Bay region (San Mateo, San Francisco, Marin and Sonoma Counties) resemble the *obesulus* types very closely in pile coloration, the yellow pile being generally darker than in specimens from other localities. Also the extent of abdominal opacity is generally greater in this group. It should be stressed, however, that the opacity and various pilosity characters vary independently and follow different clines, which need further study. Nevertheless, the Bay region specimens may be regarded as belonging to one infraspecific group which resembles the type of *obesulus* in most characters. On the other hand, another infraspecific group consists of specimens from all other known parts of the range of the species, generally of lighter yellow pilosity and less extensive opacity, generally resembling the types of *obesulus* in fewer characters than members of the first group, and with some individuals, mostly females, resembling the types of *amabilis*.

In addition to the type series of *obesulus* and *amabilis* (M.C.Z. type no. 12703, one male and two females), 161 specimens have been seen from the following localities: California: San Mateo (June 21), Colma (May 1), San Mateo County; San Francisco (April 2, 9, 11, 12, 18, 19, 20, 23, 26, 28, 30, May 2, 3, 5, 10, 11, 12, 13, 21, 22, 25, 29); Mill Valley (March 26), Marin County; Sonoma County; Lone Pine (May 19), Inyo County; Crescent Meadows, 7000-9000 ft., Sequoia National Park (June 19), Tulare County; Owens Valley, 7000 ft. (May 31), Sardine Creek, 8500 ft. (July 12), Leavitt Meadows (June 28), Blanco's Corral, White Mts., 10,000 ft. (June 23, 24, 29, 30), Mono County; Sonora Pass (June 27, July 11, 16), Tuolumne-Mono Counties; China Flat (June 28), Fallen Leaf Lake, 6500 ft. (July 16), Angora Lake (June 27), El Dorado County; Kings Beach 5 miles NW (July 5), Placer County; Sagehen near Hobart Mills (June 25, July 2), Blue Canyon (June 15), Nevada County; La Porte (September 23), Onion Valley (July 7), Plumas County; Herlong (May 14), Summit Camp (June 28), Lassen County; no locality (May 21), Shasta County; Carrville, 2400-2500 ft. (June 16), Trinity County. Nevada: Harrison Pass (May 30), Elko County. Oregon: Eagle Ridge, Klamath Lake (May 16, June 2), Fremont National Forest, 5000 ft. (June 18), no locality (May 22), Klamath County; Mt. Hood (June 15), same, 3000-5000 ft. (June 22, 24, 25), Clackamas-Hood River Counties; Wilton (June 22). Washington:

Asotin (June 27), Asotin County; Naches River (June 8), North Yakima (May 7), Yakima County; Wenatchee (May 4), Chelan County; Lind (April 23, 25), Adams County; Perry (May 12). Idaho: Lewiston (April 27); Mt. Moscow (June 24); Whitebird Summit (June 30); Camp Howard (July 5); Lava Hot Springs; 13 miles S. of Oakley, Cassia County. Wyoming: Jenny Lake, Grand Tetons (June 25). Utah: Garden City (July 2); Logan Canyon (June 21, 24); E. Canyon Dam (June 20), Morgan County; Provo (April 7); Uinta County; Alpine (May 31); Eureka (June 8); Silver Lake; South Creek, Beaver County. Colorado: Willow Park. British Columbia: Shingle Creek Road, Keremeos (June 15); Chilcotin (May 15); Nicola Lake (May 27).

Conophorus fenestratus (Osten Sacken)

Ploas fenestrata Osten Sacken, 1877, Western Diptera, Bull. U.S. Geol. Surv. 3(2):260-261 [syntypes: Crafton (near San Bernardino) and San Rafael, California, Museum of Comparative Zoology; Sonoma County, California, American Museum of Natural History].

Conophorus fenestratus, Kertesz, 1909, Catalogus Dipterorum 5:103.

Osten Sacken states that his description is based on three males and one female. The males include the one from Crafton (M.C.Z. type no. 12702) and the one from Sonoma County as listed above. The third male is apparently one from Mt. Tamalpais, Marin County, California, which is also labeled as M.C.Z. type no. 12702, but this locality is not mentioned in the original description. The single female is from San Rafael (also M.C.Z. type no. 12702); the antenna of this individual is illustrated (Figure 5). All four were collected by Osten Sacken.

Osten Sacken's description is as follows:

"♂ ♀—Wings dark brown along the anterior margin; all the veins (except the seventh) and cross-veins broadly clouded with brown. Hyaline spaces in the following cells: the two outer submarginal and the distal half of the inner submarginal; the end of the first posterior; the three other posterior; the discal; the whole axillary; nearly the whole anal (except at both ends). A hyaline spot in the distal half of the second basal cell. Head and thorax beset with long black and shorter pale yellowish-gray pile, the latter thicker and longer on the occiput, the chest, and the pleurae. Antennae black, with a very stout first joint and an unusually elongated subcylindrical second joint more than half as long as the first. Thoracic dorsum black, opaque; scutellum, when denuded, shining. Abdomen black, opaque; on the hind margin of each segment, a cross-band of whitish-gray recumbent pubescence, which expands in the middle so as to coalesce with the preceding cross-band; in the middle of each cross-band, on the hind margin of each segment, there is a more or less triangular spot of brownish-fulvous hair; these spots gradually diminish on each subsequent segment; the whole abdomen is beset, besides, with black, erect pile. Legs black in intact specimens, with a dense covering of brownish-fulvous scales, more whitish on the anterior part of the femora. Halteres reddish-yellow. Length 10-11 mm."

Fenestratus is most closely allied to *collini*, with which it forms a group having the second antennal segment elongated, the proboscis long and slender with small, rounded labella and the wings heavily marked with

dark clouds. *Fenestratus* lacks the median groove in the scutellum found in *collini;* other differentiating characters are discussed under the latter species. In some populations of *fenestratus* the wing markings are much lighter and in others darker than in the syntypes. An extreme in light wing coloration is reached in a series of six from Maricopa Grade, San Luis Obispo County, California (E. P. Van Duzee), California Academy of Sciences, and one from west of Shaver's Well, Riverside County, California, Los Angeles County Museum.

The pupa has been described (Priddy, 1939) and is illustrated for the first time in Figure 1 of the present paper. (See also above under Biology.)

A total of 191 specimens has been seen during the present study, including the types at the Museum of Comparative Zoology. The localities and dates of collection are as follows: California: San Miguel Island (May), Santa Barbara County; San Diego (February 22), Alpine (April 9), San Diego County; west of Shaver's Well (April 7), La Quinta (October 1), Whitewater Canyon (February 24, March 3, April 2), Temecula (April 24), Perris, 2 miles N (March 28), Riverside (March 10, 13, 21, 25, April 1, 4), Riverside, 4 miles S (March 29), Riverside, 5 miles SW (April 4, 9), Keen Camp (May 16), Riverside County; Laguna (May 7), Orange County; Crafton, Colton (March 29, 30), Cajon Pass (April 13), Mojave Desert (April 23), San Bernardino County; Lone Pine (May 19), Independence (April 6), Inyo County; Pasadena (March 12, April 6), Griffith Park, Los Angeles (April 15), Westwood Hills (May 1), Santa Monica Mountains (March 20), Los Angeles foothills (May 5), Mount Wilson (June 5), Frenchmans Flats (August 3), Red Rock Canyon (May 2), Llano 2 miles SW (April 13), Los Angeles County; Bakersfield, 20 miles east (April 6), Woody (April 24), no locality (May), Kern County; Maricopa Grade (March 21), San Luis Obispo County; Lemon Cove (March 29), Sequoia National Park (March 12), Sequoia National Park, Ash Mountain (April 26), Tulare County; Pinnacles National Monument (April 24), San Benito County; Big Sur (April 7), Marina (April 8), Monterey County; San Antonio Ranger Station (March 19), Santa Clara County; San Francisco (March 16); Mount Diablo (April 24), Russelman Peak, Mount Diablo (April 26), Contra Costa County; Mount Tamalpais (April 14, 21, May 25), Mill Valley (April 13, 21), San Rafael (April 12), Woodacre, Fairfax (April 22), Cypress Landing (March 29, April 6), no locality (March 23), Marin County; Spring Mountain (April 10), The Geysers (May 10), no locality (April 27-May 9), Sonoma County; Mix Canyon (April 1), Solano County; Kennedy Meadow (July 4), Tuolumne County; China Flat (June 28), Pyramid Ranger Station (July 12), Snowline Camp (June 19, 20), El Dorado County; Auburn (April 10, 11), Placer County; Blue Canyon (April 15), Nevada County; Sutter Buttes (April 2), Sutter County; Herlong (May 7, 14), Lassen County; Alturas (May 21), Cedar Pass (June 29), Modoc County. Oregon: Hood River (May 15). Washington: Asotin (June 27). Idaho: Boise, 2692 ft. (May 19), Fruitvale, 3070 ft. (June 13), Dickey, Custer County (June 28); 13 miles S of Oakley. Utah: Clarkston (June 12). An additional locality, Death Valley, California, is listed by Riley, according to Aldrich's Catalogue, but I have not seen material from there.

Conophorus collini new species

MALE. Ground color black, opaque, dorsum brownish pollinose. Eyes not contiguous, separated narrowly by front anterior to ocellar triangle. Ocellar tubercle with long black and short yellowish pile. Upper part of occiput with long black pile and yellowish tomentum. Pilose area of face broad, with black and yellowish pile interspersed. Second antennal segment at least twice as long as it is broad, nearly as long as the third segment, not including the style. First and second antennal segments with long black and shorter yellow pile. Proboscis long, slender, not extending beyond the antennae, labella small and rounded; palps slender, short, extending about half the distance toward the upper oral margin.

Mesonotum with black pile and yellowish tomentum. Mesopleura with black and yellowish pile interspersed. Scutellum bilobate, posterior margin with median groove; anterior portion opaque, posterior portion shining black; with scattered long black pile; groove filled with dense tuft of yellowish tomentum; opaque area with curly yellowish tomentum; lateral extremities with dense tufts of short yellowish pile. Metapleura bare. Halter knobs nearly black, fading into brownish yellow near the stalk. Squamae with fringe of yellow, brown and black hairs. Legs black; femora with black pile and a few white hairs; tibial spines black; femora and tibiae with appressed yellowish tomentum. Anterior and posterior coxae yellowish pilose; middle coxae yellowish and black pilose.

Wings with three submarginal cells; partly subhyaline, the rest dark brown, mostly sharply defined, infuscated areas; one large infuscated area on the basal and anterior portion of the wing, extending apically beyond the termination of the second vein in the costa, and including the costal, subcostal, marginal and first basal cells, all of the second basal except one or two hyaline spots just proximal to the branching of the fourth vein, margin of anal cell along the fifth vein, apical third of anal cell, extending slightly into the axillary cell near its apex, margin of fourth posterior cell contiguous to anal cell, basal third of fourth posterior and of discal cell, basal two-thirds of first submarginal cell, basal half of first posterior cell, extending posteriorly from the latter as a wide band along both sides of the vein between discal and second posterior cell and the vein between second and third posterior cells, nearly to the margin of the wing; from the apex of the marginal cell extending posteriorly as a broad, dark band along both sides of the veins that divide the first (proximal) submarginal from the other two submarginal cells, and from here extending beyond the third vein into a small portion of the first posterior cell; smaller, isolated infuscated areas, including one along both sides of the anterior branch of the third vein near the apex of the wing, which is nearly continuous with the main dark area where the latter extends along the costal margin toward the apex; two faint spots near the posterior margin of the wing, on the veins separating the first posterior cell from the third submarginal and the second posterior cells; a band along both sides of the vein between the third and fourth posterior cells, extending nearly to the margin of the wing, and sometimes continuous with the main dark area along the vein between discal and third posterior cells. Costa strongly to moderately serrate.

Dorsum of abdomen yellowish tomentose with long, stout black hairs on all segments; lateral fringe of abdomen consisting of long, stout black hairs, with tufts of shorter black pile near the anterior margins, and yellowish pile near the posterior margins of the segments. Venter white and yellowish tomentose, with scattered black hairs on the third and following segments. Length of body 8 mm.; length of wing 7.5 mm.

FEMALE. Similar to male; front very broad, with long black and shorter yellow pile interspersed; squamae with yellow and brown hairs; costa not serrate.

Holotype male, and *allotype* female, Oceano, San Luis Obispo County, California, April 24, 1951 (R. M. Bohart), from J. C. Hall; deposited in the California Academy of Sciences.

Paratypes. 6 males and 2 females, same data as holotype; 1 female, Zaca Mountain, Santa Barbara County, California, April 24, 1951 (R. M. Bohart), J. C. Hall collection. One male, Ventura County, California, April 13, 1936, R. M. Bohart collection. 1 male, same data as holotype, Carnegie Museum, type no. 335. This species is dedicated to Mr. J. E. Collin, whose comparisons of specimens made possible its recognition.

C. collini is near *fenestratus,* from which it can be distinguished most readily by a median groove in the scutellum, which is occupied by a dense tuft of light-colored tomentum. The pattern of wing markings is also slightly different from that in *fenestratus,* the clouding along the third vein being interrupted proximal to the point where the vein branches. The individuals seen are considerably smaller than the average size for *fenestratus.* See below for comparison with *pictipennis.*

Conophorus pictipennis (Macquart)

Ploas pictipennis Macquart, 1841, Diptères exotiques nouveaux ou peu connus, Mem. Soc. Sci. Arts Lille, 2(1):107, Plate 9, fig. 3. (type: "Caroline"; Bigot Collection, in the collection of Mr. J. E. Collin, Newmarket, Suffolk, England.)
Conophorus pictipennis, Kertesz, 1909, Catalogus Dipterorum, 5:103 (syn., distr.).

This species has not been seen and the above is not a complete synonymy.

A translation of Macquart's description follows:

"Blackish, with yellowish hair. With bilobate scutellum. With wings black-spotted.

"Thorax with anterior band of pale gray. Scutellum shining black, grooved in the middle of the posterior margin. Legs brownish yellow. Halteres fulvous. Wings spotted with brown on most of the veins and particularly on the cross-veins, base brown with two small clear spots.

"De la Caroline. Cabinet de M. Serville."

Collin states *(in litt.)* that the locality given on the label of the type is "Carolina" without any doubt, but that it is in Bigot's handwriting, not that of Macquart.

As this species has not been seen by the writer it is not included in the key. There is apparently no record of it in American collections, and it is listed among North American species only because the type locality is given as "Caroline," and Aldrich's "Catalogue of North American Diptera"

(1905) lists it as from "Carolina." Collin has compared supposed specimens of *pictipennis* from California with the type, but has found that they do not belong to this species. The material sent him is therefore described above in this paper as a new species, *C. collini*. Collin indicates that the type of *pictipennis* (Macq.) differs from these California specimens in wing markings, venation and thoracic markings as well as in having a shorter second antennal segment—not much more than half the length of the third segment.

The identity of this species has been in confusion. Kertesz lists *macroglossa* L. Dufour and *mauritanicus* Bigot as synonyms of *pictipennis* (Macq.), and gives the distribution of the species as southern Europe, northern Africa and North America. Séguy (1926) gives the same synonymy but in addition lists here the *pictipennis* of Aldrich's "Catalogue" with a question, apparently indicating doubt that the latter is the same as *pictipennis* (Macq.). On the other hand, Collin writes that the *pictipennis* of Séguy (1926) is not that of Macquart, and appears to be *mauritanicus* Bigot. There seems to be sufficient reason to tentatively regard *pictipennis* (Macq.) as probably palaearctic in distribution and therefore outside the territory now considered.

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AEDES (OCHLEROTATUS) BARRI, A NEW SPECIES OF MOSQUITO FROM MINNESOTA (DIPTERA, CULICIDAE)[1]

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The larva of this species was first collected in Itasca State Park, Clearwater County, Minnesota during May, 1954, by Dr. A. Ralph Barr, for whom the species is named. It appeared to be close to the form of *Aedes riparius* Dyar and Knab figured by Rempel (1950), but different from the form of *Ae. riparius* collected and reared from the St. Paul, Minnesota area. In May, 1956, the author collected additional larvae in Itasca State Park and obtained a small series of individually reared adults. Examination of the male terminalia revealed that this mosquito represents a species which in the larval stage most closely resembles *Ae. riparius*, but whose male terminalia appear to be identical to those of *Aedes excrucians* (Walker) and probably also to those of *Aedes annulipes* (Meigen), a European species of this group. In the pattern of the mesonotum, it most closely resembles *Ae. excrucians*. The claw of the female differs from that of *Ae. excrucians* but appears to be very similar to that of *Aedes fitchii* (Felt and Young) and *Aedes stimulans* (Walker).

This new species of *Aedes* belongs to the subgenus *Ochlerotatus*, Group B (*annulipes* group: *Lepidoplatys*) which Edwards (1932, p. 136) distinguished by: tarsi of at least the hind legs with basal white rings on all segments; male basistyle (coxite) with distinct apical lobe, basal lobe variable in development and usually with one spine; lower mesepimeral bristles present; larva with 5 to 6 ventral tufts on anal segment before the grid, and with unpigmented gills. A description of the female, male, fourth instar larva, and pupa is presented.

Aedes (Ochlerotatus) barri n. sp.

DESCRIPTION OF FEMALE

HEAD: Proboscis dark brown with a few scattered white scales, especially near the mid-area, but lacking a definite white ring. Palpus dark brown with a few scattered white scales, especially on the basal segment; about as long as the three basal flagellar segments of the antenna; a few dark brown hairs on penultimate segment. Antenna with dark integument; about as long as the proboscis; torus brown, the inner surface darker and with white scales on the dorso-medial area. Clypeus dark, nude. Vertex (as defined in Carpenter and LaCasse, 1955, p. 8) with slender, golden brown scales and golden hairs. Occiput with the anterior dorsal region and the lateral areas white scaled, the latter with a small, central area of black scales; occipital hairs dark brown; posterior (nape) area with erect, forked, dark brown

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scales and a few erect, forked, light yellow scales with an intermingling of light golden, slender, partly erect scales.

THORAX: Scutum dark brown covered with narrow, brown-red scales with a pattern of narrow, light golden scales consisting of: (a) two submedian, small, faint to definite, round to rectangular spots near the middle of the anterior half of the scutum in line with the dorsocentral bristles, (b) two submedian spots near the middle of the scutum usually joined to two narrow, submedian stripes bordering the prescutellar space, and (c) a narrow margin along the anterior and lateral margins of the scutum and a wider margin at the supraalar area. Bristles brown-red. Scutellum with light golden, narrow, curved scales and gold-brown to brown-red bristles. Anterior pronotum with light golden, flattened scales; dark brown bristles on the upper half and light golden bristles on the lower half. Posterior pronotum with brown-red, narrow, curved scales on the upper part, white flattened scales on the lower half, and a clump of golden brown bristles. Postcoxal area with white scales. Spiracular area with both hypostigial spot of scales and spiracular bristles absent. Postspiracular area with white, flattened scales and a clump of light golden postspiracular bristles. Propleuron with white, flattened scales and a clump of light golden bristles. Sternopleuron with white, flattened scales along the posterior margin, the posterior half of the upper margin, and the prealar knob; the scales of the latter two narrowly separated. Light golden bristles along the posterior and upper margins of the area and on the prealar knob. Mesepimeron with white, flattened scales extending approximately two-thirds of the way to the ventral margin, and a clump of light golden upper mesepimeral bristles; lower mesepimeral bristles usually absent, but 1 or 2 may be present. Meron bare. Metameron with white, flattened scales. Postnotum brown, nude. Metanotum with halter brown, knob with light golden scales. Wing scales predominantly dark brown with white scales intermixed; usually a patch of pale scales at the base of the costa. Length of wing approximately 5 mm. Coxa and trochanter of fore, middle, and hind leg with white scales and golden bristles. Femora and tibiae covered with dark and white scales anteriorly; the posterior surfaces with white scales and the knee spots white. Tarsi of fore leg dark with faint to definite, narrow, basal, white band on segments 1, 2, and sometimes 3. Tarsi of middle leg with narrow, basal, white band on segments 1, 2, 3, and sometimes 4. Tarsi of hind leg with narrow, basal, white band on segment 1 and broad, basal, white band on segments 2, 3, 4, and 5. Claws toothed and as figured in Plate 1.

ABDOMEN: First tergite with a large, median patch of white scales and scattered light golden bristles. Remaining tergites dark brown scaled with basal, white, segmental bands; a narrow margin of white scales on the apical margin of most tergites. Sternites largely covered with white scales, the median areas with black scales.

Length of mosquito, not including proboscis, approximately 6.4 mm. Specimens examined: 10; an additional 75 reared specimens in the collection of Dr. Roger D. Price, Entomology and Economic Zoology, University of Minnesota, St. Paul (UMStP) were examined for mesonotal pattern and lower mesepimeral bristles.

DESCRIPTION OF MALE

HEAD: Palpus dark brown scaled with broad, basal, white band on segments 2, 3, and 4, and a mixture of white and dark brown scales on the subapical portion of segment 3; long hairs on apical half of segment 3 and base of segment 4; longer than the proboscis. Antenna plumose. Otherwise similar to female.

THORAX: Scutum covered with brown-red, narrow, curved scales with a pattern of light gold, narrow, curved scales consisting of: (a) a narrow submedian stripe in line with the dorsocentral bristles on the posterior half and joined to an angled stripe going below the scutal angle, (b) a pair of faint to definite spots near the middle of the anterior half of the scutum along the line of the dorsocentral bristles, or forming short stripes joined to the submedian stripes of the posterior half of the scutum, and (c) narrow margins along the anterior margin of the scutum and a wider margin at the supraalar area; or the entire area lateral of the dorsocentral bristles may be covered with the light golden scales. Otherwise similar to female.

ABDOMEN: Dark brown scaled with basal, white bands on segments 2 through 7; the bands indented medially on segments 6 and 7. Otherwise similar to female.

TERMINALIA (Plate 1): Lobes of ninth tergite rounded, each with about 6 or 7 slender, long spines. Tenth sternite heavily sclerotized beyond the middle, 3 small setae laterally. Phallosome longer than wide, open ventrally, closed dorsally, notched at the apex. Claspette stem long, slender, pilose on basal half; claspette filament shorter than the stem, angularly expanded to a sharp point at the base, tip curved. Basistyle about four times as long as the midwidth, clothed with scales and long and short setae; basal lobe represented by an elongate, rugose area reaching to near base of apical lobe and clothed with numerous short setae arising from tubercles; apical lobe large, broadly rounded, clothed with short setae. Dististyle about one-half as long as the basistyle (average of 4 specimens: without claw of dististyle, 0.56; with claw of dististyle, 0.69), broader medially, and bearing a few subapical setae; claw slender, about one-fourth as long as the dististyle (average of 4: 0.23).

Length of mosquito similar to female. Number of specimens examined: 11; an additional 52 reared specimens from the collection of Dr. Roger D. Price (UMStP) were examined for mesonotal pattern and lower mesepimeral bristles.

DESCRIPTION OF LARVA

Plate 1. The descriptive terminology used is that of Belkin (1950, 1953). The number of branches in hair tufts, number of comb scales and pecten teeth, and so forth are given in the following order: range, followed by mode, median, and number examined in parentheses (a dash indicating not applicable); length (where applicable; with mode, median, and number in parentheses when determined); description, with the degree of development of the hairs classified as fine, moderate, or heavy.

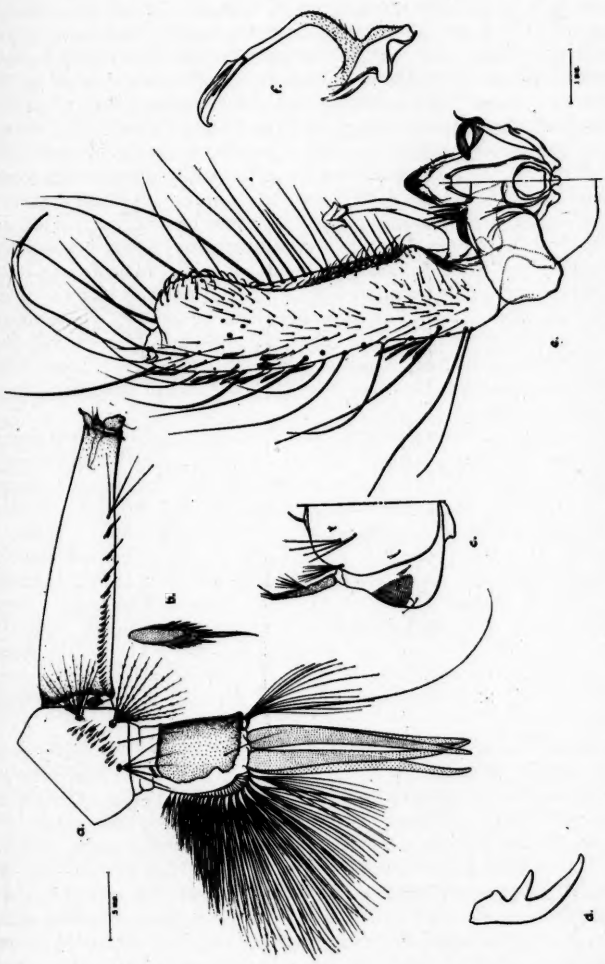

PLATE I

Aedes barri n. sp. Figures a-c, larva. a. Terminalia, b. comb scale, c. head, d. tarsal claw of prothoracic leg of adult female. Figures e-f. male terminalia, f. claspette.

ANTENNA: Length 0.46-0.60 mm. (—; 0.52; 34), shorter than head; slender, tapering slightly, spiculate, usually darker than head. Antennal hair 1: 4-7 (5; 5; 20); 0.165-0.285 mm. (—; 0.24; 24); moderate, individual hairs not barbed, usually not reaching tip of antenna (23 did not, 1 did), inserted at 0.34-0.57 (0.46; 0.46; 30) of antennal length, from base.

HEAD: Width about 1.5 × length; integument yellow-brown, darkened anteriorly and posteriorly, ocular areas lighter; mental plate with 23 to 25 teeth. Hairs 1, 5, 6, and 7 dark brown, others yellow-brown. Hair 1: 1 (1; 1; 38); about 0.175 mm.; heavy, spinelike. Hair 4: 3-6 (4; 4-5; 24); about 0.166 mm.; fine, usually slightly dendritic. Hair 5: 1-3 (2; 2; 77); 0.46-0.59 mm. (—; 0.55; 27); heavy, usually not barbed, usually not quite reaching base of hair 1. Hair 6: 1-4 (2; 2; 81); 0.42-0.60 mm. (—; 0.50; 31); heavy, usually not barbed, usually reaching slightly beyond base of hair 1. Hair 7: 4-8 (7; 7; 35); 0.35-0.55 mm. (—; 0.43; 29); moderate, usually not barbed, usually reaching just beyond insertion of antennal hair 1. Hair 8: 1-4 (2; 2; 30); about 0.17 mm.; fine. Hair 9: 1-4 (3; 2; 33); about 0.16 mm.; fine. Hair 10: 1-2 (1; 1; 29); about 0.14 mm.; fine. Hair 11: 3-8 (5; 5; 22); about 0.08 mm.; fine. Hair 12: 1 (1; 1; 32); about 0.20 mm.; fine. Hair 13: 3-13 (6; 6; 31); about 0.06 mm.; fine, dendritic. Hair 14: 1 (1; 1; 31); about 0.08 mm.; moderate, spinelike. Hair 15: 3-8 (5; 5; 30); about 0.06 mm.; fine, often slightly dendritic.

PROTHORAX: Integument glabrous. Hair 0: about 10-20 branches; about 0.07 mm.; fine, dendritic. Hair 1: 1 (1; 1; 33); about 1.23 mm.; heavy, usually barbed. Hair 2: 1 (1; 1; 37); about 0.46 mm.; moderate, smooth. Hair 3: 2-4 (3; 3; 33); about 0.20 mm.; fine, smooth. Hair 4: 1-2 (1; 1; 34); about 0.28 mm.; moderate, smooth. Hair 5: 1 (1; 1; 36); about 1.52 mm.; heavy, barbed. Hair 6: 1 (1; 1; 35); about 1.38 mm.; heavy, barbed. Hair 7: 3-4 (3; 3; 35); about 1.47 mm.; heavy, barbed. Hair 8: 1-3 (1; 1; 25); about 0.94 mm.; heavy, barbed. Hair 9: 1 (1; 1; 24); about 0.46 mm.; heavy, barbed. Hair 10: 1 (1; 1; 26); about 0.46 mm.; moderate, smooth. Hair 11: 2-5 (4; 4; 15); about 0.07 mm.; fine, smooth. Hair 12: 1 (1; 1; 21); about 1.4 mm.; moderate, smooth. Hair 14: 1-2 (2; 2; 9); about 0.16 mm.; fine, smooth. Pigmented plates at bases of hairs 7 through 12; apices of long hairs attenuated.

MESOTHORAX: Integument glabrous. Hair 1: 3-6 (3; 4; 13); about 0.10 mm.; fine, smooth. Hair 2: 1-5 (2; 2; 13); about 0.07 mm.; fine, smooth. Hair 3: 1 (1; 1; 20); about 0.45 mm.; moderate, smooth. Hair 4: 1-3 (2; 2; 19); about 0.30 mm.; moderate, smooth. Hair 5: 1 (1; 1; 36); about 2.05 mm.; heavy, barbed. Hair 6: 6-8 (8; 7; 13); about 1.7 mm.; heavy, barbed. Hair 7: 1 (1; 1; 15); about 1.9 mm.; heavy, barbed. Hair 8: 7-11 (10; 10; 11); about 1.7 mm.; heavy, barbed. Hair 9: 7-11 (9; 9; 17); about 1.9 mm.; heavy, barbed. Hair 10: 1 (1; 1; 21); about 1.45 mm.; heavy, barbed. Hair 11: 1-2 (2; 2; 5); about 0.03 mm.; fine, smooth. Hair 12: 1 (1; 1; 18); about 1.15 mm.; heavy, barbed. Hair 13: about 15-20; about 0.07 mm.; fine, smooth, dendritic. Hair 14: about 15-20; about 0.10 mm.; fine, smooth, dendritic. Pigmented plates at bases of hairs 5 through 12; apices of long hairs attenuated.

METATHORAX: Integument glabrous. Hair 1: 2-4 (2; 2; 5); about 0.20

mm.; fine, smooth. Hair 2: 2-5 (2; 2; 15); about 0.20 mm.; fine, smooth. Hair 3: 10-13 (11; 11; 16); about 0.14 mm.; fine, smooth. Hair 4: 4-8 (5; 5; 16); about 0.10 mm.; fine, smooth. Hair 5: 1 (1; 1; 21); about 0.08 mm.; moderate, smooth, spinelike. Hair 6: 1-2 (1; 1; 31); about 0.35 mm.; moderate, smooth. Hair 7: 10-16 (12; 12; 31); about 1.20 mm.; heavy, barbed. Hair 8: about 15-20; about 0.06 mm.; fine, smooth, dendritic. Hair 9: 5-8 (6; 6; 19); about 2.0 mm.; heavy, barbed. Hair 10: 1 (1; 1; 29); about 2.0 mm.; heavy, barbed. Hair 11: 1-2 (2; 2; 4); fine, smooth. Hair 12: 1 (1; 1; 24); about 0.35 mm.; moderate, smooth. Hair 13: about 10-20; about 0.13 mm.; fine, smooth, dendritic. Pigmented plates at bases of hairs 7, and 9 through 12; apices of long hairs attenuated.

ABDOMEN: Finely spiculate in the comb area and often ventrally on segments II through VI (visible at 100x and 200x). *Segment I:* Hair 6: 1-4 (2; 2; 54); about 1.45 mm.; heavy, barbed. Hair 7: 1-2 (1; 1; 52); about 1.55 mm.; heavy, barbed. *Segment II:* Hair 6: 1-3 (2; 2; 47); about 1.6 mm.; heavy, barbed. Hair 7: 1-6 (3; 3; 38); about 0.60 mm.; moderate, smooth. *Segment III:* Hair 6: 1-2 (2; 2; 49); about 1.50 mm.; heavy, barbed. Hair 13: 1 (1; 1; 40); about 1.30 mm.; heavy, barbed. *Segment IV:* Hair 6: 1-2 (2; 2; 50); about 1.30 mm.; heavy, barbed. Hair 13: 1 (1; 1; 37); about 1.34 mm.; heavy, barbed. *Segment V:* Hair 1: 2-11 (5,6; 5; 52); 0.11-0.50 mm. (—; 0.24; 28), the length decreasing as the number of branches increases; fine to moderate, smooth. Hair 6: 2 (2; 2; 50); about 1.10 mm.; heavy, barbed. Hair 13: 1 (1; 1; 34); about 1.32 mm.; heavy, barbed. *Segment VI:* Hair 6: 1-2 (2; 2; 39); about 1.20 mm.; heavy, barbed. *Segment VII:* Hair 1: 1-2 (2; 2; 24); about 0.35 mm.; heavy, barbed. *Segment VIII:* Hair 1: 5-9 (7; 7; 34); about 0.60 mm.; heavy, barbed. Hair 2: 1 (1; 1; 37); about 0.35 mm.; moderate, smooth, base not pigmented, inserted separately from hair 1. Hair 3: 6-11 (9; 9; 31); about 0.70 mm.; heavy, barbed. Hair 4: 1-2 (1; 1; 36); about 0.35 mm.; moderate, smooth. Hair 5: 3-7 (5; 4; 33); about 0.45 mm.; heavy, smooth. Comb scales: 14-19 (16; 16; 50); in an irregular single row, individual scale with a long median spine and smaller lateral spinules. Pigmented plates at bases of number 6 hairs, I-7, and VIII-1, -3, and -5; apices of long hairs attenuated.

SIPHON: Length (at pecten, excluding valves): 1.75-2.14 mm. (—; 1.91; 19). Width: at base 0.46-0.70 mm. (—; 0.55; 19); at hair tuft insertion 0.35-0.53 mm. (—; 0.41; 19); at apex 0.25-0.35 mm. (—; 0.27; 19). Siphon index (length divided by basal width): 2.93-4.23 (—; 3.45; 19). Pecten teeth: 17-24 (20; 20; 38); the apical 2-5 (4; 4; 54) widely spaced; pecten extending 0.56-0.66 (0.62; 0.62; 38) of siphon length; evenly spaced teeth with 2 or more subbasal spines, the widely spaced teeth often lacking subbasal spines; apical pecten tooth length: 0.15-0.21 mm. (0.19; 0.19; 37). Hair 1: 2-3 (3; 3; 43); 0.42-0.62 mm. (0.46; 0.47; 27); moderate, sometimes slightly barbed, slightly shorter than basal width of siphon, slightly longer than width of siphon at hair tuft insertion, not reaching apex of siphon. Hair 2: 1 (1; 1; 12); 0.03-0.06 mm. (—; 0.05; 12), shorter than apical pecten tooth; fine, smooth. Hair 9: 1 (1; 1; 20); about 0.08 mm.; moderate, smooth, spinelike, straight to slightly curved. Acus strongly developed.

ANAL SEGMENT: Saddle: length 0.57-0.71 mm. (—; 0.64; 19); extending about two-thirds of the way around segment; ventral margin incised near apex; acus detached; spines on apex about 10-13 μ in length, usually flanked by minor spines; setal area spine groups of about 5 to 10 homogeneous spines, the groups separate but the individual spines joined on a basal ridge, individual spines about 3-4 μ in length; lateral area spine groups of about 6 to 16 homogeneous spines, the spine groups separate and the individual spines not joined by a basal ridge, individual spines about 4-5 μ in length. Hair 1: 1 (1; 1; 21); 0.31-0.46 mm. (—; 0.40; 17); moderate, smooth. Hair 2: 8-12 (10,11; 11; 35); about 0.83 mm.; moderate, smooth. Hair 3: 1 (1; 1; 31); about 2.2 mm.; heavy, smooth, apex attenuated. Hair 4: 23-27 tufts (25; 25; 18), each tuft with about 5 to 7 hairs, 4-6 (6; 6; 19) tufts basad of grid; longest about 0.37 mm., shortest about 0.27 mm.; moderate, smooth. Anal gills: 4; 0.92-2.06 mm. (—; 1.20; 65), dorsal pair often longer than ventral pair; apices attenuated, pointed.

DESCRIPTION OF PUPA

Plate 2. The descriptive terminology follows that of Belkin (1953); the number of hairs in each tuft is given in the following order: range, followed by mode, median, and number examined in parentheses. All branches were counted since in the shorter tufts both the primary and secondary branching often occurred near the base. Relative position, length, and degree of development of hairs as figured. Integument of pupa yellow-brown, hairs yellow-brown to brown-yellow.

CEPHALOTHORAX: Trumpet: length about 0.81 mm.; width at base about 0.07 mm.; width at widest point about 0.24 mm.; pinna about 0.11 mm.; notched at apex, surface reticulated and with small spicules.

METATHORAX: Hair 10: 1-6 (2; 3; 35). Hair 11: 1-3 (2; 2; 38). Hair 12: 1-5 (2; 2; 33).

ABDOMEN: Length (without paddles or genital lobes) about 4.3-4.8 mm. Reticulation between hair 1 on tergum I well developed, line of reticulation heavy; sternites II through VIII with fine spicules in the mid-area. *Segment I:* Hair 1: about 50 or more branches. Hair 2: 1-2 (1; 1; 37). Hair 3: 1-3 (2; 2; 30). Hair 4: 1-5 (2; 2; 27). Hair 5: 2-10 (7; 6; 29). Hair 6: 1-2 (1; 1; 36). Hair 7: 1 (1; 1; 34). Hair 10: 1-2 (2; 2; 33). *Segment II:* Hair 0: 1 (1; 1; 28). Hair 1: 7-15 (11; 11; 35). Hair 2: 1 (1; 1; 41). Hair 3: 1-3 (2; 2; 40). Hair 4: 3-10 (5; 5; 30). Hair 5: 3-7 (5; 5; 37). Hair 6: 1-2 (1; 1; 32). Hair 7: 1 (1; 1; 28). Hair 10: 1-2 (2; 2; 31). *Segment III:* Hair 0: 1-2 (1; 1; 32). Hair 1: 3-10 (5; 5; 37). Hair 2: 1 (1; 1; 43). Hair 3: 1-2 (2; 2; 43). Hair 4: 3-8 (5; 5; 39). Hair 5: 4-8 (5,7; 6; 41). Hair 6: 1-3 (1; 1; 31). Hair 7: 1 (1; 1; 28). Hair 8: 1-6 (4; 4; 38). Hair 10: 2-11 (6; 6; 35). Hair 11: 1 (1; 1; 38). Hair 12: 1-4 (2; 2; 31). Hair 14: 1 (1; 1; 32). *Segment IV:* Hair 0: 1 (1; 1; 33). Hair 1: 2-7 (4; 4; 39). Hair 2: 1 (1; 1; 39). Hair 3: 1-7 (4,5; 4; 42). Hair 4: 1-6 (2,4; 3; 33). Hair 5: 2-3 (2; 2; 36). Hair 6: 1-3 (2; 2; 36). Hair 7: 1 (1; 1; 27). Hair 8: 1-4 (2; 2; 34). Hair 10: 1-6 (2; 3; 30). Hair 11: 1 (1; 1; 37). Hair 12: 1-4 (1; 1; 35). Hair 14: 1 (1; 1; 26). *Segment V:* Hair 0: 1 (1; 1; 26). Hair 1: 1-4 (2; 2; 33). Hair 2: 1-2 (1; 1; 39). Hair 3: 1-3 (2; 2; 42). Hair 4: 2-9 (4; 5; 39). Hair 5: 1-3 (2; 2; 36).

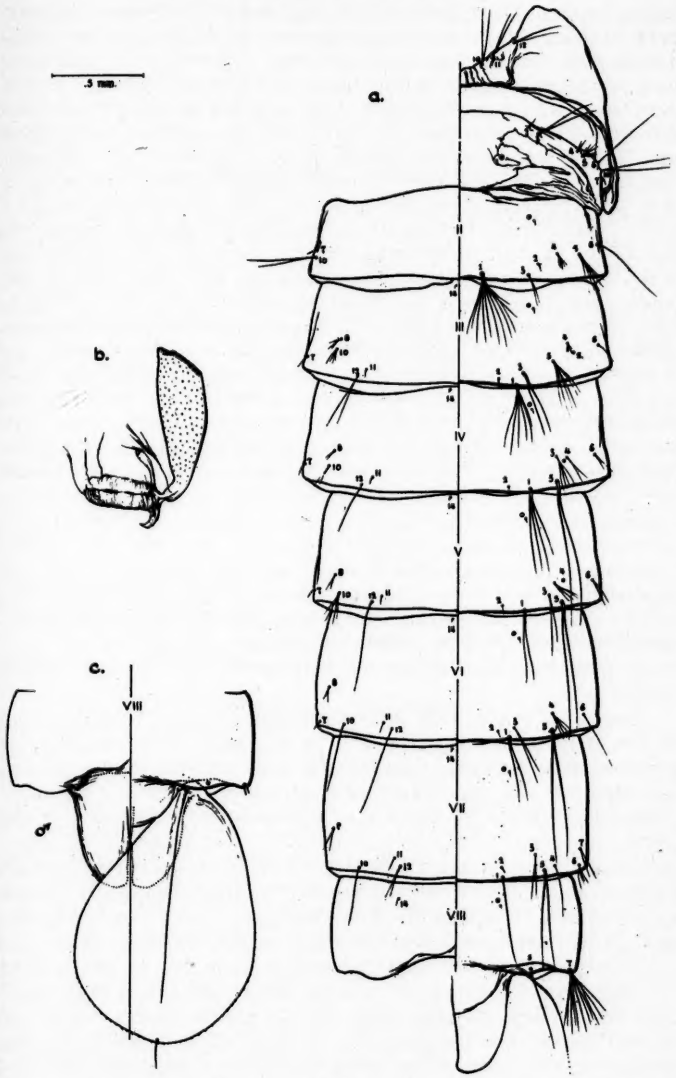

PLATE II

Aedes barri n. sp., pupa. a. Metathorax and abdomen of male. b. respiratory trumpet. c. apex of abdomen and paddle of male.

Hair 6: 1-3 (2; 2; 37). Hair 7: 1 (1; 1; 23). Hair 8: 1-4 (2; 2; 33). Hair 10: 2-8 (6; 5; 32). Hair 11: 1 (1; 1; 38). Hair 12: 1 (1; 1; 31). Hair 14: 1 (1; 1; 31). *Segment VI:* Hair 0: 1 (1; 1; 32). Hair 1: 2-4 (2; 2; 35). Hair 2: 1 (1; 1; 42). Hair 3: 1-3 (2; 2; 37). Hair 4: 2-6 (4; 4; 40). Hair 5: 1-2 (2; 2; 35). Hair 6: 1-2 (1; 1; 38). Hair 7: 1 (1; 1; 32). Hair 8: 1-5 (3,4; 3; 39). Hair 10: 1-2 (1; 1; 35). Hair 11: 1 (1; 1; 39). Hair 12: 1 (1; 1; 33). Hair 14: 1 (1; 1; 22). *Segment VII:* Hair 0: 1-2 (1; 1; 39). Hair 1: 1-3 (1; 1; 35). Hair 2: 1 (1; 1; 43). Hair 3: 1-5 (2; 2; 40). Hair 4: 1-2 (1; 1; 40). Hair 5: 1-3 (2; 2; 41). Hair 6: 1-8 (4; 4; 37). Hair 7: 2-4 (2; 2; 38). Hair 8: 1-4 (3; 3; 37). Hair 10: 1 (1; 1; 38). Hair 11: 1 (1; 1; 39). Hair 12: 1 (1; 1; 40). Hair 14: 1-2 (1; 1; 19). *Segment VIII:* Hair 0: 1 (1; 1; 39). Hair 5: 1 (1; 1; 40). Hair 7 (primary hairs): 4-8 (6; 6; 39). Hair 14: 1-2 (1; 1; 39). *Paddle:* Hair 1: 1-2 (1; 1; 37); length of paddle about 1.15(♀)-1.36(♂) mm., width about 0.85(♀)-0.92(♂) mm., index (length divided by widest width) about 1.36(♀)-1.48(♂); ♂ genital lobe extending to about 0.43 of paddle, ♀ genital lobe extending to about 0.38 of paddle; segment IX extending to about 0.17(♂)-0.21(♀) of paddle; paddle ovate in shape, surface sparsely clothed with minute spicules, more numerous and heavier on external half; marginal denticles posteriorly, arranged in two or three incomplete rows, the apical row projecting slightly beyond paddle margin; midrib strongly sclerotized, evanescent apically.

TYPES

Holotype ♂ (author's 20 V I 56-18) with associated larval and pupal exuviae, Itasca State Park, Clearwater County, Minnesota, 20 May 1956, reared from larva collected in swamp along side of north boundary road, approximately 0.3 mi. from corner west of north arm of Lake Itasca (M. E. Rueger), to be deposited in the U.S. National Museum (USNM): number 64085.

Allotype ♀ (author's 20 V G 56-19) with associated larval and pupal exuviae, Itasca State Park, Minnesota, 20 May 1956, reared from larva collected in lakeside marsh of cattails and sedge grass between entrance to University of Minnesota (Forestry and Biological Station) and Headquarters of Park (M. E. Rueger), to be deposited in the USNM; number 64085.

Paratypes: 1 ♀ (author's 20 V G 56-15) with associated larval and pupal exuviae and fore tarsal claw mounted on slides, same data as allotype; 1 ♂ (author's 20 V I 56-17) with associated larval and pupal exuviae, genitalia and hind tarsal claw mounted on slides, same data as holotype; and 4 whole larvae (showing variation in branching of certain hairs) mounted on slides (author's 5 V B 57-4, -36, -41 and 4 V H 57-53), Itasca State Park, Minnesota, sedge grass pool in bushes and trees along Lind Saddle Trail, west of Douglas Lodge, 5 May 1957 and marshy area along Middlewest Trail about 5.7 mi. from University of Minnesota entrance, 4 May 1957 (M. E. Rueger): to be deposited in the USNM (number 64085). 1 ♂ (author's 20 V G 56-36) and 1 ♀ (author's 20 V G 56-26) with associated larval and pupal exuviae, genitalia and hind tarsal claw of ♂, and

fore tarsal claw of ♀ mounted on slides, same data as allotype; and 1 whole larva (author's 5 V B 57-21) mounted on slide, Itasca State Park, Minnesota, sedge grass pool in bushes and trees along Lind Saddle Trail, west of Douglas Lodge, 5 May 1957 (M. E. Rueger): to be deposited in the Department of Entomology and Economic Zoology Collection, University of Minnesota, St. Paul.

DISTRIBUTION AND BIONOMICS

Aedes barri has been collected only in Itasca State Park and only in the larval stage. This park is situated in northwestern Minnesota. Its forests consist of northern coniferous and southern deciduous types; many bog areas are present. Larval collections were made in the Park Rapids area, about 18 mi. south, at the same time; no larvae of this species were present in these collections. In Itasca State Park it appeared to prefer marshy sites containing sedge grass. It was very prevalent during early spring; 42 larvae were collected by the author in May 1956, and in April and May 1957, hundreds were collected by Dr. A. Ralph Barr (Dept. of Entomology, University of Kansas, Lawrence: UKL), Dr. Roger D. Price (UMStP), and the author. Twenty-one specimens were individually reared by the author; larger series were reared by Drs. Barr and Price (Price, 1957) in 1957. Rearing was difficult unless the larvae were near pupation. In 1957 the larvae were first collected on the 27th of April. These were predominantly in the third instar. They were still present in collections made on the 29th of May (Price, 1957). In the author's collections *Ae. barri* was associated with the following species of *Aedes: canadensis* (Theobald), *cinereus* Meigen, *diantaeus* (Howard, Dyar and Knab), *excrucians, fitchii, intrudens* Dyar, *punctor* (Kirby), *riparius, stimulans, trichurus* (Dyar), *vexans* (Meigen), and also with *Culiseta morsitans* (Theobald).

TAXONOMIC DISCUSSION

The females of the *annulipes* group occurring in North America (*Ae. barri, Ae. excrucians, Ae. fitchii, Aedes flavescens* (Muller), *Aedes increpitus* Dyar, *Ae. riparius,* and *Ae. stimulans*) form a rather homogeneous series. Separation is therefore difficult even with perfect specimens. Individually reared specimens of these species, with the exception of *Ae. increpitus* which does not occur in Minnesota, are being studied by the author. From the study thus far, it appears that the females of *Ae. barri* can be separated from *Ae. excrucians* and *Ae. riparius* by the fore tarsal claw and from *Ae. flavescens* by the pattern of scaling on the abdomen and mesepimeron. The claw of *Ae. excrucians* has the main tooth abruptly bent near the base of the lateral tooth which is elongate and parallel with the main tooth (Vockeroth, 1950; Rempel, 1953; Carpenter and LaCasse, 1955, p. 179). *Aedes riparius* has the main tooth gradually bent, usually near its apex. The lateral tooth is short, blunt appearing, not parallel with the main tooth, and less than one-half as long as the main tooth (Vockeroth, 1950; Rempel, 1953; Carpenter and LaCasse, 1955, p. 223). *Aedes barri* has the main tooth gradually bent before its apex but slightly beyond the base of

the lateral tooth. The length of the lateral tooth is about one-half that of the main tooth and the two are not parallel with each other. The abdominal tergites of *Ae. flavescens* are clothed with yellow scales, without basal bands, and the mesepimeron has the scaling extending to or almost to the lower margin, whereas *Ae. barri* has the abdominal tergites dark with definite pale basal bands and the lower third of the mesepimeron bare. Carpenter and LaCasse (1955, p. 139) separate *Ae. increpitus* from *Ae. fitchii* and *Ae. stimulans* by the absence of long hairs on the palpus. This character would also serve to separate it from *Ae. barri*. As yet no constant characteristics have been found by which the females of *Ae. barri, Ae. fitchii,* and *Ae. stimulans* may be separated. The claws of these three species appear to be indistinguishable, the number of lower mesepimeral bristles vary, and the mesonotal patterns intergrade. Carpenter and LaCasse (1955, p. 139) use the number of lower mesepimeral bristles to separate the females of *Ae. fitchii* and *Ae. stimulans,* the former having zero to rarely more than two and the latter usually having three or more. The individually reared females of *Ae. stimulans* in the author's study appear to show considerable variation in number of lower mesepimeral bristles. Nine of 38 specimens, on which both the right and left mesepimeron were examined, had two or less bristles on either side. By using the number of lower mesepimeral bristles and the mesonotal pattern, it may be possible to separate most specimens of these three species. *Aedes fitchii* usually has a brown-red median stripe with light golden scales laterally, the mesonotum of *Ae. stimulans* is golden brown with a faint indication of a median brown-red stripe, and *Ae. barri* has light golden scales forming spots or short stripes on the brown-red mesonotum. Characters of the male terminalia and larvae offer more satisfactory means of distinguishing the species of this group.

The male genitalia of *Ae. barri* appear to be identical with those of *Ae. excrucians;* however, it appears that the two can be separated by examination of the mounted hind tarsal claw. The lateral tooth of the claw on male *Ae. excrucians* is not as parallel with the main claw as that of the female, but the abrupt bending of the main claw near the base of the lateral tooth appears to be distinct. A reference set of the claws from reared specimens is useful for comparison.

The larvae of *Ae. barri* are distinct, but may be confused with *Ae. intrudens* and *Ae. riparius*. The *Ae. riparius* collected in the St. Paul area by the author had the pecten only on the basal half of the siphon, the siphon shorter and not as tapered as for *Ae. barri,* comb with about six to eight scales, the lateral abdominal hairs usually single on segments III through VI, and hairs 1 and 2 on abdominal segment VIII arising from a shared sclerotized plate. These *Ae. riparius* larvae appear to be very similar to the one figured by Carpenter and LaCasse (1955, p. 223) and those in the original description by Dyar (1923). Reared males had the characteristic *Ae. riparius* genitalia. The larval stage of *Ae. riparius* as figured by Rempel (1950) appears to be very similar to *Ae. barri:* the pecten extends beyond the middle of the siphon, the siphon is more tapered and longer than on the form collected in the St. Paul area, comb with 11 scales, the lateral abdominal hairs double on segments III through VI, and hair 2 on abdominal

segment VIII not arising from the sclerotized plate at the base of hair 1. The figure of the male genitalia by Rempel (1953) appears to be typical of *Ae. riparius*. The larvae of *Ae. barri* are distinct from those of *Ae. excrucians;* no difficulty was experienced in separating the two. In addition to the characteristics given by Carpenter and LaCasse (1955, p. 180) for *Ae. excrucians* (pecten not quite reaching the middle of the siphon, comb with 17 to 33 scales in a patch, siphonal hair 1 longer than the basal diameter of the siphon, lateral abdominal hair 6 usually single on segments III through VI), the abdominal hair 1 on segments III, IV, and V is well developed and about 1.3 mm. in length. Although the entire study of the abdominal chaetotaxy of *Ae. barri* has not been completed as yet, it appears that hair 1 is short on segments III and IV and short to moderate on segment V. Although the male genitalia of *Ae. barri* and *Ae. annulipes* are similar, the larvae are distinctly different. The latter, as figured by Marshall (1938, p. 196), has 31 to 44 comb scales in a patch and the pecten composed of evenly spaced teeth extending less than half of the length of the siphon.

It is hoped that the following modifications and additions to the key of Carpenter and LaCasse (1955, p. 144), using their terminology and style, will aid in the recognition of *Ae. barri*. Since head hair 5 of *Ae. barri* may be two or three branched on both sides, it will key out as near *Ae. intrudens* and *Ae. riparius*.

KEY TO LARVAE (FOURTH INSTAR)

(Carpenter and LaCasse, 1955, p. 146)

32 (31). Hairs of siphonal tuft about as long as the basal diameter of the siphon; saddle of the anal segment deeply incised on ventral margin 32a
Hairs of siphonal tuft rarely more than half as long as the basal diameter of the siphon; saddle of the anal segment not deeply incised on the ventral margin ....*vexans* (Meigen), p. 264

32a (32). Lateral abdominal hair 6 usually single on III-VI; pecten with about 13-18 teeth .....*intrudens* Dyar, p. 201
Lateral abdominal hair 6 usually double on III-VI; pecten with about 20 teeth (17-24) .....(in part) *barri* Rueger

37 (36). Upper frontal head hair 5 and lower frontal 6 usually single .....*ventrovittatus* Dyar, p. 252
Upper frontal head hair 5 and lower frontal 6 usually double..37a

37a (37). Comb with about 6-11 scales;[3] pecten with 14-17 teeth; upper caudal tuft of dorsal brush (anal segment hair 2 of Belkin, 1950) with about 4-6 hairs .....*riparius* D. and K., p. 223
Comb with about 16 scales (14-19); pecten with about 20 teeth (17-24); upper caudal tuft of dorsal brush (anal segment hair 2 of Belkin, 1950) with about 10 or 11 hairs (8-12) ....(in part) *barri* Rueger

[3] A number of larval specimens, not individually associated with adults in the USNM collection but determined as *Ae. riparius* by Dyar, have more than 12 comb scales (Stone, 1957).

Using Darsie's two keys to *Aedes* pupae (1951, 1955), the pupa of *Ae. barri* would key to 16A with *Ae. stimulans* although it does not completely fit in some of the couplets. In couplets 8, 14, 15, and 16 it is necessary to consider all the characters and select the couplet half in which a majority applies. It may be separated from *Ae. stimulans* by the following characters: *Ae. barri* with MT-10 generally 2- or 3-branched (1-6), II-1 generally 11-branched (7-15), II-5 5- or 6-branched (3-7), IV-1 generally 4-branched (2-7); *Ae. stimulans* with MT-10 generally 7-branched (4-10), II-1 generally 7-branched (7-9), II-5 generally 2-branched (2-4), IV-1 generally 2-branched (1-3).

ACKNOWLEDGMENTS

Sincere appreciation and thanks are extended to: Dr. A. Ralph Barr (UKL) for suggesting the study of this species, use of drawings prepared for his revision of Minnesota mosquitoes (1958), and helpful suggestions and assistance; Dr. Alan Stone (USNM) for comparing specimens of the species with those of related species at the USNM; Sylvia Barr (UKL) for preparing the drawings; Dr. Roger D. Price (UMStP) for his helpful suggestions and assistance; Dr. Alexander C. Hodson (UMStP), Dr. Laurence K. Cutkomp (UMStP), and Prof. Theodore A. Olson, School of Public Health, University of Minnesota, Minneapolis 14, for criticism of the manuscript and helpful suggestions.

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A DESCRIPTION OF THE LARVA AND PUPA OF *CULISETA (CULICELLA) MINNESOTAE* BARR (DIPTERA, CULICIDAE)[1]

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This paper presents a description of the previously undescribed larval and pupal forms of *Culiseta (Culicella) minnesotae* Barr. The erection of this species by Barr (1957) was based only on male and female specimens taken in Minnesota, the immature stages being unknown to him at that time. During the summer of 1956 and the spring of 1957, the present writer took a number of *Culicella* larvae and, upon rearing a portion of them to the adult stage, it was determined that they represented *C. minnesotae* instead of the closely related *Culiseta (Culicella) morsitans* (Theobald), the only other member of the subgenus *Culicella* occurring in North America. Barr (1957) had been unable to assign his new species with certainty to a subgenus, but the finding of these larvae confirms his belief that it belongs to the *Culicella* subgenus. In view of the fact that *C. minnesotae* and *C. morsitans,* as a result of this close relationship, have undoubtedly both fallen into the *C. morsitans* category in references in the past literature, it is of interest to make a detailed description of the immature forms of *C. minnesotae* to determine morphological differences between these stages of the two species.

The following descriptions are based on twelve sets of associated larval and pupal skins, three fourth-instar larvae, one fourth-instar larval skin, and three third-instar larvae, all of these specimens being collected in Ramsey Co., Minn., from July 19 to August 14, 1956. During the spring of 1957, two other breeding spots of *C. minnesotae* were located and examination of the critical characters was made to supplement the data for the above specimens. Twenty fourth-instar larvae collected at Itasca State Park, Clearwater Co., Minn., from May 31 to June 7, 1957, and eight fourth-instar larvae from Cedar Creek Forest, Isanti Co., Minn., June 3, 1957, were utilized for this purpose.

The *C. morsitans* material originally used for comparative purposes consisted of six pairs of associated larval and pupal skins (one from Dryden, Tompkins Co., New York, April 4, 1948, and five from Cayuta Lake, Schuyler Co., New York, May 8-22, 1948) furnished by Dr. Richard F. Darsie, Jr., Department of Entomology, University of Delaware Agricultural Experiment Station, and four larval skins, two pupae, and two pupal skins (Cedar Creek Forest, Isanti Co., Minn., May 11-17, 1956) furnished by Miss Myrtle E. Rueger, School of Public Health, University of Minnesota. The author would like to express his gratitude to these individuals for making this material available to him. From May 7-24, 1957, this worker was fortunate in being able to collect large numbers of *C.*

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morsitans larvae at Itasca State Park and fifty of these fourth-instar larvae were examined to confirm the differences previously noted.

The systems of numbering the larval and pupal setae follow those proposed by Belkin (1950, 1952, 1953). In the following descriptions, the usual number of setal branches is given and, if the limits of variation of branching differ from this, these limits are given in parentheses.

LARVA

FOURTH INSTAR (Pl. I). Length 7-8 mm. *Head:* Wider than long (Fig. 1, Pl. I). Postclypeal 4 usually double or triple (1-4); upper frontal 5 multiple, usually 7- or 8-branched (6-11), barbed, the longest branches extending beyond apical margin of head; lower frontal 6 always double or triple, barbed, very long, twice length of longest upper frontals; preantennal 7 multiple, 9- to 12-branched (8-14), barbed. Sutural 8 double or triple, rarely 4-branched, medium length; transsutural 9 usually triple (2-4), medium; orbital 10 usually single or double (1-4), medium. *Antenna:* As long as head, curved, strongly spiculated on basal two-thirds; antennal tuft 1 multiple, barbed, inserted at constriction near outer third of shaft and extending beyond tip of antenna; inner and outer subapical setae 2-3 long, single, inserted together equidistant between antennal tuft and tip of antenna; terminal seta 4 long; hyaline process 5 very short; segmented finger process 6 about third length of 4. *Prothorax:* Accessory dorsal 0 tufted, relatively short; hairs 1-2 single, 3-4 double, 5-6 single, all very long, surpassing the head in length (Fig. 2, Pl. I). Hair 7 multiple, 3- to 5-branched, barbed, half as long as 1-6; dorsolateral 8 usually triple (2-3), barbed, of same length as 7. Pleural group with 10 and 12 very long, single, 9 half as long, single, and 11 short, distally 3- to 5-branched. Median ventral 14 double, medium. *Mesothorax:* Dorsals 1 usually single (1-2), medium; 2 short, distally 2- to 4-branched; 3 long, single; 4 fairly long, distally 2- to 3-branched; and 5-7 very long, single. Dorsolateral 8 long, multiple (4-8). Pleural group with 9 a long multiple tuft (4-7), 10 and 12 very long, single, and 11 minute, single. Ventrolateral 13 and median ventral 14 relatively short and tufted. *Metathorax:* Dorsals 1 short, single; 2 medium, single or distally 2- to 3-branched; 3 medium, 4- to 5-branched (3-9); 4 short, distally 2- to 3-branched; 5 short, single or double; 6 long, single; and 7 long, multiple (5-10). Dorsolateral 8 short, multiple (5-9). Pleural group with 9 long, multiple (4-8); 10 very long, single; 11 short, single or distally bifid; and 12 long, distally 2- to 4-branched. Median ventral 13 stellate, 4- to 8-branched. *Abdomen:* Lateral abdominal hairs 6-7 both well-developed, barbed, and multiple on segments I-II; 6 single, long, on segments III-VI and 7 reduced to a small multiple tuft. Comb of segment VIII consisting of many scales (50-100) in a patch (Fig. 3, Pl. I); individual scale expanded outwardly and fringed both laterally and apically with subequal spinules (Fig. 5, Pl. I). Siphon six to seven times as long as basal width, tapering slightly; pecten of few teeth (7-13) on basal fourth, with several distal teeth detached. Individual tooth pointed, slender, with several subequal teeth along basal two-thirds of one side (Fig. 4, Pl. I). Siphonal tuft 3- to 7-branched, inserted within pecten near base of siphon. Anal segment much

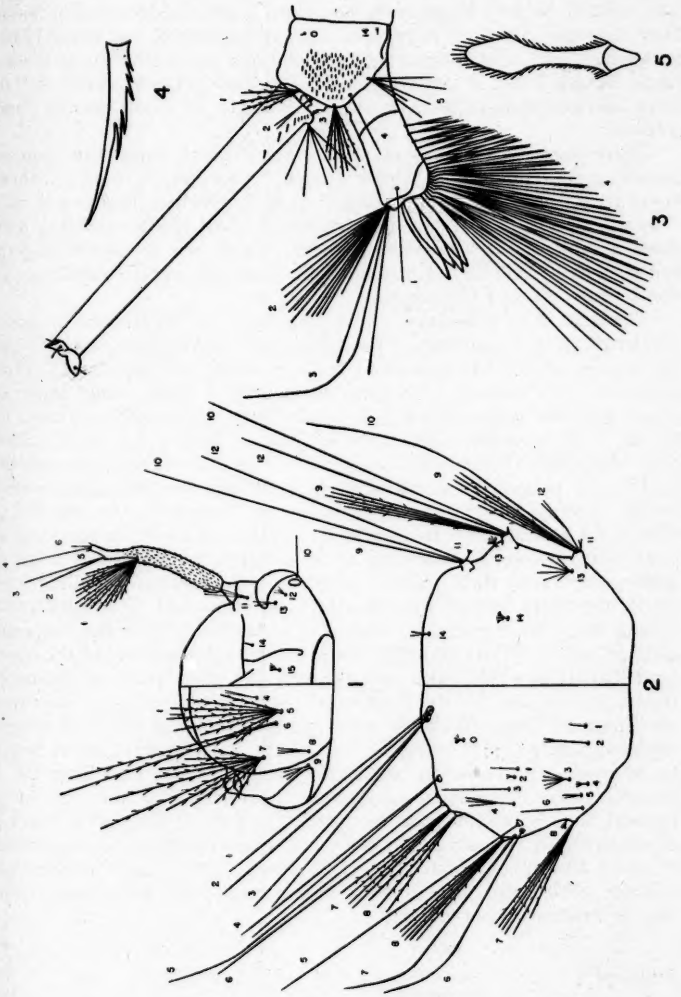

PLATE I

Culiseta (Culicella) minnesotae Barr, fourth-instar larva. Fig. 1. Head, dorsal (left) and ventral (right) views. Fig. 2. Thorax, dorsal (left) and ventral (right) views. Fig. 3. Terminal segments. Fig. 4. Pecten tooth. Fig. 5. Comb scale.

longer than wide, completely ringed by saddle; lateral hair 1 usually single, rarely double, slightly longer than the saddle. Upper caudal tuft 2 of dorsal brush multiple (10-16), relatively long; lower caudal tuft 3 of dorsal brush 3-branched (2-4), consisting of one very long hair and two subequal shorter hairs. Ventral brush 4 well-developed with 16-19 tufts, of which five to seven are precratal. Gills about the same length as saddle, slender, and pointed.

THIRD INSTAR. Essentially as in the fourth instar, except for reduced branching of certain hairs. Upper frontal 5 multiple, 3- to 5-branched; lower frontal 6 double; preantennal 7 6- to 8-branched. Prothoracic hair 7 only 2- to 3-branched; hair 8 always single. Anal saddle extending only about a third of the way down segment; lateral hair 1 inserted slightly below lower margin in indentation. Both upper and lower caudal tufts of dorsal brush reduced in branching.

The larva of *C. minnesotae* can be separated from the larva of *C. morsitans* by utilizing in combination the branching of head hairs 4, 5, and 7, and the number of tufts in the ventral brush of abdominal segment IX. Postclypeal 4 of *C. minnesotae* is generally double or triple, rarely single or quadruple. The upper frontal 5 is usually 7- or 8-branched, less often 6-, 9-, 10-, or 11-branched; never were both upper frontals on one specimen only 6-branched. Preantennal 7 is typically 9- to 12-branched, although the 8-, 13-, and 14-branched states were observed; however, both preantennals on the same specimen were never as few as 8-branched. The number of tufts of the ventral brush are usually 17-18, rarely 16 or 19. As compared to these hairs, those of *C. morsitans* are as follows: Postclypeal 4 is single or double, very rarely triple, usually described in the literature as minute and single; the upper frontal 5 is typically 4- or 5-branched, although also attaining the 3-, 6-, or rarely the 7-branched state. Ross (1947) and Carpenter and LaCasse (1955) substantiate this as the typical branching of the upper head hair. Dyar (1928) also confirms the 4-branched nature of the upper frontal and implies that the American *C. morsitans* larva agrees fully with the European larva. Abundant work on this species by several European workers, Natvig (1948) being the most recent, has shown the upper frontal to be single to 4-branched, apparently rarely, if ever, exceeding the 4-branched state. Preantennal 7 is usually 6- to 8-branched although an occasional 5- or 9-branched hair was noted. The tufts of the ventral brush of *C. morsitans* are typically 20 in number, rarely less than this and occasionally 21 or 22. Illustrations from Dyar (1928), Ross (1947), and Carpenter and LaCasse (1955) also show 20 tufts in this brush. The above comparisons may be summarized as follows:

Hair	Species	N	Range	$\bar{X}$	σ
Postclypeal 4	morsitans	121	1- 3	1.3	0.49
	minnesotae	84	1- 4	2.3	0.60
Upper frontal 5	morsitans	112	3- 7	4.8	0.69
	minnesotae	76	6-11	7.9	1.23
Preantennal 7	morsitans	93	5- 9	7.1	1.02
	minnesotae	73	8-14	10.6	1.39
Ventral brush 4	morsitans	61	19-22	20.4	0.81
	minnesotae	44	16-19	17.7	0.71

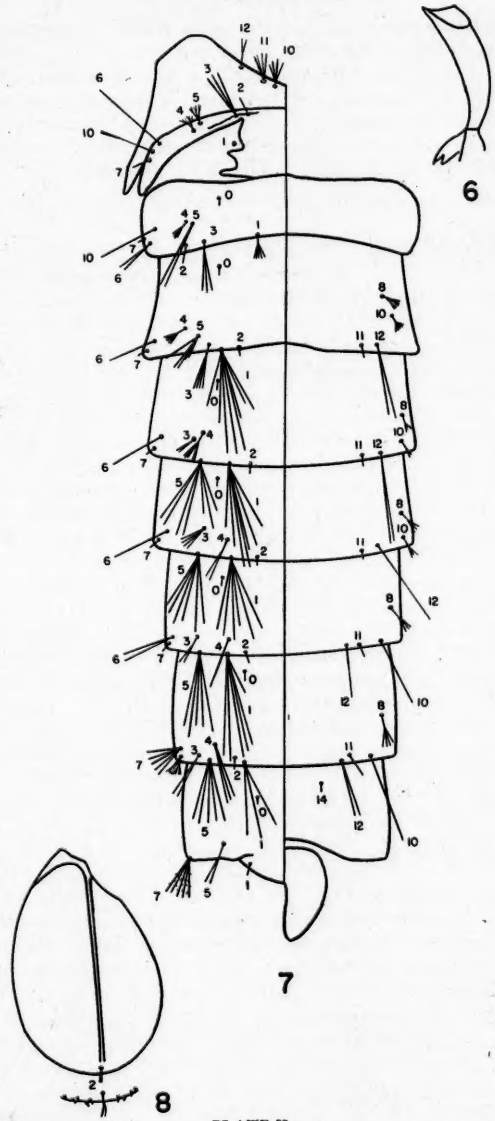

PLATE II

Culiseta (Culicella) minnesotae Barr, pupa. Fig. 6. Respiratory trumpet. Fig. 7. Metathorax and abdominal segments, dorsal (left) and ventral (right) views. Fig. 8. Paddle.

It is quite interesting to note at this point that the chaetotaxy of *C. minnesotae* as described in this paper agrees in virtually every detail with that of *Culiseta (Culicella) nipponica* LaCasse and Yamaguti, 1950. Unfortunately these workers made only a single collection of these larvae on the island of Hokkaido, Japan, and based this new species only on this stage. Were the adult and pupal stages known, an enlightening comparison could be made with the corresponding stages of *C. minnesotae*.

PUPA

Cephalothorax: Setae 1-2 usually double (1-3), 3-4 triple (2-4), 5 double (1-3), 7-9 double (1-3), all of these setae being relatively long. Seta 6 medium, usually single (1-2). Metathoracic setae medium, 10-11 generally 4- to 5-branched (3-6) and 12 2- to 3-branched (1-4). Respiratory trumpet gradually widening apically (Fig. 6, Pl. II). *Abdomen* (Fig. 7, Pl. II): Hair 0 absent on I; single, medioanterior, minute on II-VIII. Hair 1 a well-developed float-hair on I; medium, 5- to 7-branched on II (5-11); long, 5- to 7-branched on III-VI (3-9); long, usually triple on VII (2-4); absent on VIII. Hair 3 long, 3- to 5-branched on I-III (2-6); medium, double or triple on IV (1-4); 5- to 6-branched on V (3-8); generally double on VI-VII (1-3); absent on VIII. Hair 4 increasing from relatively short to fairly long posteriorly, 8- to 11-branched on I (6-14), 4- to 6-branched on II-IV (3-8), single or double on V-VI (1-3), triple on VII (3-4), absent on VIII. Hair 5 fairly short, 5- to 7-branched on I (3-10); long, usually double on II (1-3); medium, 4- to 5-branched on III (4-6); long, 4- to 6-branched on IV-VII (3-7); medium, double on VIII (1-2). Hair 6 single, long on I; medium, usually double on II (1-4); long, single on III-V (1-2), double on VI (1-3), relatively short and 5- to 8-branched on VII (3-9), absent on VIII. Hair 7 short, single on I (1-2); minute, single on II-VI; medium, 4- to 5-branched on VII (3-6); 4- to 6-branched, barbed on VIII. Hair 8 absent on I-II; medium, usually 2- to 4-branched on III-VII (1-5); absent on VIII. Hair 10 long, double or triple on I (2-4); long, single on II; medium, triple on III (1-5); medium, double on IV (1-3); medium, 4-branched on V (3-7); long, usually single on VI-VII (1-2); absent on VIII. Hair 11 absent on I-II; short, single on III-VII; absent on VIII. Hair 12 absent on I-II; long, generally double on III-IV (1-4); long, usually single on V-VI (1-2); long, single or double on VII; absent on VIII. Hair 14 minute, single, medioanterior, present only on VIII. Seta 1 on IX minute, single. Paddle ovoid, apical fourth of border with small marginal and submarginal denticles (Fig. 8, Pl. II); midrib not reaching apex; terminal seta 2 short, single or double.

The only detailed pupal description of *C. morsitans* known to the writer is that of Darsie (1951). Here, perhaps even more so than with the larva, distinct differences are present in the branching of certain setae. *C. morsitans* has single cephalothoracic setae 1 and 2, whereas *C. minnesotae* shows these setae more typically double, rarely single or triple. A much more distinctive difference, however, exists in the branching of seta 7 on abdominal segments VII-VIII. Darsie found this seta always to be single on both segments of *C. morsitans* and he utilized this character among others to differentiate this species from *Culiseta (Culiseta) inornata* (Williston).

The pupae of the *C. morsitans* from Minnesota occasionally show seta 7 double on segment VII, but it is invariably relatively long and single on VIII. Contrasted to this, seta 7 of *C. minnesotae* is 3- to 6-branched on VII and 4- to 6-branched and barbed on VIII.

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AUGOCHLORODES, A NEW GENUS OF HALICTINAE FROM BRASIL (Hymenoptera, Apoidea)[1]

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The form described below is named at this time in order that the name may be used in a paper on the biology of these bees by Drs. Charles D. Michener and Carlos Alberto Campos Seabra. The principal distinguishing characters of the genus are given in italics.

Augochlorodes new genus
Type species: *Augochlorodes turrifaciens* new species

FEMALE. *Head as broad as long* (110:110); eye longer than superior interorbital distance and this greater than inferior interorbital distance (88:60:50). Clypeus twice as broad as long (50:25), *epistomal suture almost straight lateral to subantennal suture,* clypeocellar distance about three times clypeoantennal distance. Frontal carina evident, well formed in lower two-thirds. Interocellar distance about equal to ocellocular (35:40; ocellar diameter 30). Genal areas almost as wide as eyes; *no preoccipital carina.*

[1] Contribution No. 980 from the Department of Entomology, University of Kansas.

Scape surpassing vertex; basal segment of flagellum slightly shorter than pedicel, equal to second and third, the latter a little shorter than its diameter. Thorax with *humeral angles of pronotum rounded,* margin between angles and lobes weakly concave. *Mesoscutum roundly projecting anteriorly, covering, in dorsal view, the median part of pronotum.* Scutellum weakly longitudinally depressed in middle. *Basal area of propodeum slightly shorter than scutellum* (20:25), shining, reticulate, with some very short carinae anteriorly. *Pterostigma very large,* vein r three-fifths length of pterostigma from base. *Inner posterior tibial spur pectinate* with three or four teeth; basitibial plate lanceolate, apical half concave; *tibial scopa reduced. Metasomal terga without vibrissae.*

MALE. *Head as broad as long* (100:100), eye longer than upper interorbital distance and this almost twice lower interorbital distance (78:56:33). Clypeus about two-thirds as long as broad (33:25), epistomal suture almost straight, lateral to subantennal suture; clypeocellar distance almost four times clypeoantennal distance (58:16). Frontal carina as in female. Interocellar distance greater than ocellocular (40:35, ocellar diameter 30). Genal areas a little narrower than eyes. No preoccipital carina. *Antennae long, scape almost attaining level of median ocellus,* basal segment of flagellum one and one-half times as long as pedicel, slightly shorter than second, this slightly shorter than third (20:30:35:40, diameter of third 22). Thorax and wings as in female. Femora a little swollen; tibiae slightly claviform, posterior basitarsus slender, two-thirds as long as tibia, posterior tibia to entire tarsus as 95:130. Metasoma elongate, but not pedunculate; second sternite elongate, posterior margin gently recurved; third with weak median apical angle; *fourth similar but also with posterior lateral extremities strongly produced and with long plumose hairs;* fifth with margin straight; sixth with margin with weak median sinus; seventh tergite small, covered by the salient sixth.

In spite of its *Augochlorella*-like aspect, the pectinate inner hind tibial spurs of the female and the lateral projections of the fourth sternite of the male suggest some relationship to *Augochloropsis.* The basal area of the propodeum and the very small sparse hairs on the eyes suggest some small *Caenaugochlora.*

Augochlorodes turrifaciens new species

FEMALE. *Color:* Green, with some bluish reflections on front, basal area of propodeum, and marginal depressions on the dark tergal bands. Mandibles, labrum, apical third of clypeus, antennae, legs, and sternites black; discs of sternites and trochanters and femora, and especially coxae with some weak green reflections. Tegulae translucent brown, with inner margins narrowly green. Wings hyaline, veins and pterostigina brown. Pilosity of wings well developed, denser in apical third, giving this area a darker color.

Pilosity: Whitish, short, a little denser on dorsum and lobes of pronotum and mesospiracular area, with some longer hairs on face, mesonotum, and especially scutellum, sparse on tergites. Tibial scopa little developed.

Punctuation: Dense and fine on the frons, a little coarser and sparser toward lower paraocular areas, coarser on clypeus where the intervals are shining and a little broader than a puncture width; supraclypeal area more finely and densely punctate above and laterally, on the disc quite sparse and almost as fine; on vertex very fine; on genal areas very fine and weakly granulate; on mesonotum fine and rather sparse (intervals four to five times as broad as punctures on posterior disc), a little denser anteriorly and clearly so antero-laterally with some coarser punctures interspersed; on scutellum fine and dense, with some coarser punctures interspersed; on metanotum only with sparse piliferous granulate punctures; on mesepisterna considerably coarser, with shining intervals anteriorly, these broader and more reticulate ventrad; on metepisterna and sides of propodeum exceedingly fine with some sparse coarser punctures; on posterior surface of propodeum exceedingly fine, sparse, with scattered coarser punctures, postbasal (dorsolateral) angles smooth; on first tergite fine and sparse on disc, sparser laterally; on second and following tergites denser, also sparser laterally than discally, marginal depressions of second to fourth terga impunctate, transversely canaliculate; on first tergite depression less distinct and very finely punctate basally.

Measurements: Length 7 mm.; wing (including tegula) 6.5 mm.; head width 1.9 mm.; metasomal width 2.4 mm.

MALE. Very similar to female. Apical third of clypeus, medial part of mandibles, a stripe on anterior tibiae, and anterior tarsi yellowish white; scape with weak metallic reflections; legs green except tarsi; sterna almost without metallic coloration. Pilosity white, rather dense on frons, less dense on dorsum, pronotum and sides of propodeum. Punctuation almost as in female; mesepisterna without reticulations.

Measurements: Length 7.5 mm.; wing (including tegula) 6 mm.; head width 1.8 mm.; metasomal width 1.7 mm.

Locality: Floresta da Tijuca, 500 meters, Rio de Janeiro, D. F., Brasil, June 11, 1956 (J. S. Moure, C. A. C. Seabra).

Types: Holotype female, allotype male, in the collection of Carlos Alberto Campos Seabra. Twenty-five paratypes distributed among collections of J. S. Moure, the University of Kansas, the U. S. National Museum, the Departmento de Zoologia da Secretaria de Agricultura do Estado de São Paulo, and the Museu Nacional, Rio de Janeiro.

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HOT WATER PREPARATION OF ADULT HOUSEFLIES FOR STUDENT USE

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When houseflies are used in the classroom, the mouthparts, often the structures most desired for close examination, may be found tucked away beneath the head. The hot water method of killing (Peterson, A. 1953. A Manual of Entomological Equipment and Methods. Edwards Bros., Ann Arbor, Mich. v+367 pp., 182 pl.) appeared to be a solution. Living houseflies were dipped directly into boiling water and boiled two minutes. After cooling, the flies were transferred to 70% ethyl alcohol for preservation. Other flies were killed or immobilized—one group chilled, another anesthetized with CO_2, a third killed with cyanide, a fourth with carbon tetrachloride—before being boiled, cooled, and preserved as above.

The mouthparts were distended in a good proportion of the flies regardless of the method of handling just prior to boiling. Best results (almost 100%) were obtained when active, living flies were dipped into boiling water. The rostrum was invariabiy straightened out, the labellum fully spread in most specimens, and the palpi were pointing ahead or up toward the face. Percent of distension was lower in pre-killed or immobilized flies but did not drop much below 50% in any case.

Preserved specimens of the first group were pinned for class use. The mouthparts remained expanded during the laboratory period without shrinkage or collapse. Mouthparts of flies that remained two weeks in the open were still fully distended although somewhat dried and shrivelled. The abdomens of boiled and preserved flies were fully distended with all ventral sclerites entirely separated by membranous areas which remained soft and flexible rather than becoming shrunken and brittle as often occurs when specimens are preserved directly in alcohol. Leg joints and wing base articulations remained flexible. The "female genitalia" were extruded in about half the specimens and stayed soft and flexible in storage. The wings retained flexibility; the body hair and bristles remained freely movable.

The general condition of the digestive and reproductive systems was quite superior to that of specimens killed by alcohol. With only reasonable care in dissecting, the specimens were entirely adequate for studies in internal morphology, although not quite equal to living specimens in this regard.

After nine months in storage in 70% alcohol, the boiled houseflies were in just as good condition in every way as when first prepared.

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